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# CITY 4

# DIRECTOR'S MANUAL

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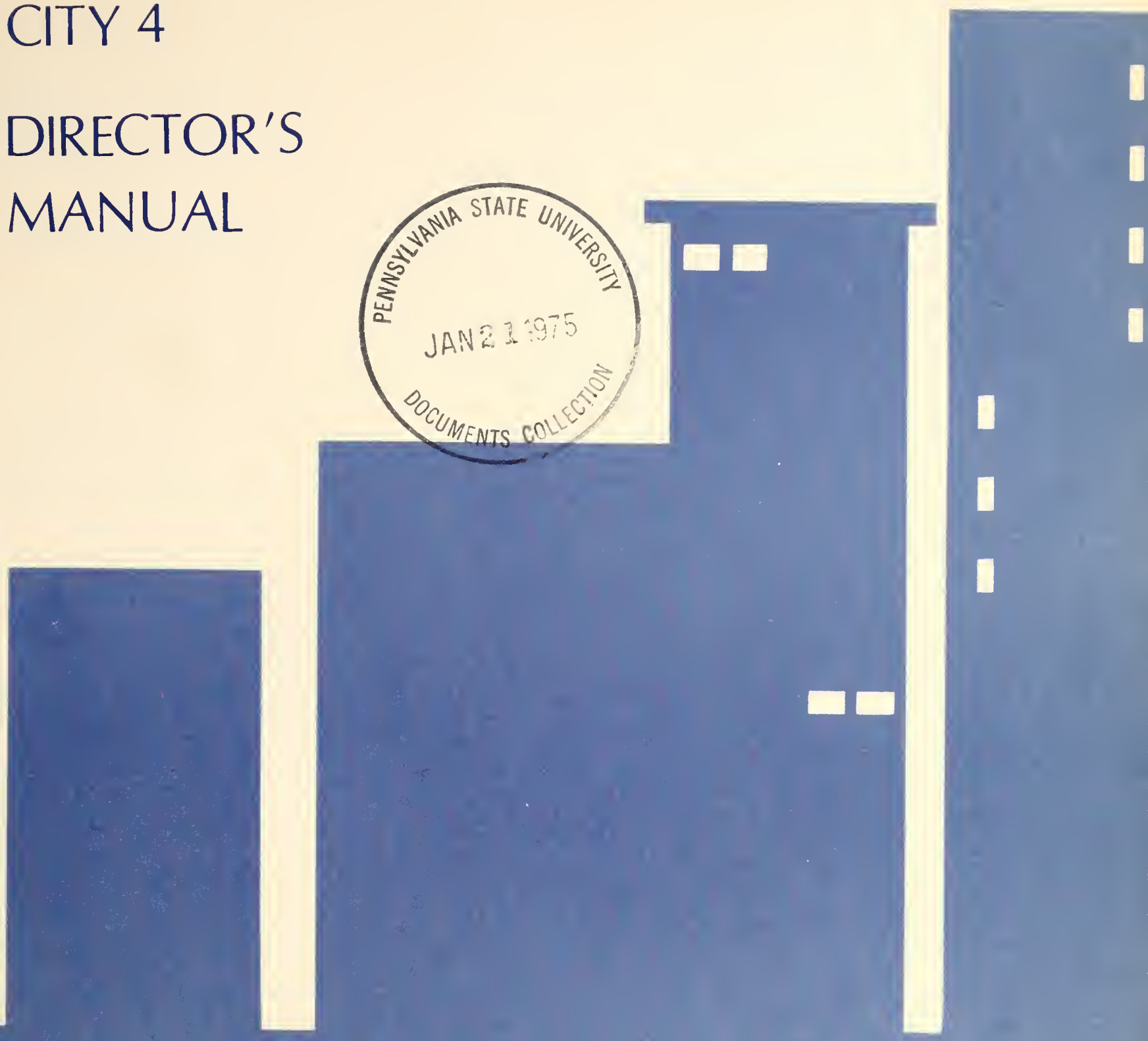

# CITY GAMES

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# CITY IV

# DIRECTOR'S MANUAL

Edited by John E. Moriarty

Technical Analysis Division
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National Bureau of Standards
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CITY IV DIRECTOR'S MANUAL

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# I. INTRODUCTION

City IV is an operational simulation game in which participants make economic, government and social decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participants' decisions as any real city would. Each player in City IV is assigned to a team which shares an economic and governmental role. The interrelated decisions made by teams will guide the way the simulated city changes in composition and size.

The simulation approach to cities offers the players an opportunity not only to make decisions but to implement them as well. They recieve a feedback from their actions and see the effects from other forces that are constantly at work altering the effectiveness of the players' decisions. Players therefore have a learning experience in how to deal with a changing environment. The round-by-round play gives the players the necessary experience in selecting the type of analysis to move them towards their objectives while the allocation of their time and Game resources is a critical determinant of the success they hope to achieve. As the Game progresses, players learn to increase their involvement in the management of the environment while at the same time learning more about the relationships between business and society.

One of the primary purposes of the Game is to improve the players' understanding of urban problems in systemic terms. In other words, the aim is to encourage players to view the activities of the City as being closely related and interdependent (e.g., an unemployment problem will exacerbate a health problem, the loss of industry and jobs in the private sector will reduce the number and quality of services offered in the public sector through reduced tax revenues, etc.). The Game also encourages players to use an interdisciplinary perspective when dealing with urban problems; that is, to look at the problem not only from the viewpoint of an economist, but also from the perspective of a geographer, planner, political scientist, etc. For instance, if a player is dealing with a land use problem such as zoning, he soon realizes that he cannot escape the broader concepts of land-use planning. The problems of housing, unemployment, education, health, highways, etc., are all related in a system of interconnected activities and institutions to his original land-use problem of zoning. Hence, many of the outputs of this particular gaming model (e.g., land use maps, economic indicator tables, etc.) are designed in such a fashion that the City can be viewed more easily as a single entity than as several separate and disparate parts.

Although no two games are ever indentical, most games have common characteristics that are noteworthy. In a typical game the economic decision makers can best be described as rather conservative and cautious players. This aversion to risk-taking is especially noticeable in the early rounds when players are uncertain as to the outcome of particular decisions. Economic decision makers generally do not have a game plan and most decisions in the

early rounds are not made in a systematic fashion or developed in a coordinated manner. In later rounds, many decisions are made as the result of actions taken in earlier rounds. For example, an economic decision maker might build some housing units for rental purposes and then find that they are underutilized. The decision maker might then consider building commercial or manufacturing establishments close by in order to induce more people to live in the underutilized housing units and build up a good supply of labor. Just as likely, the procedure would be reversed, and the emphasis would be on building housing units near a previously built manufacturing plant in order to maintain an adequate supply of labor close to the plant.

The economic decision makers usually make profits on their business operations, although losses on particular investments are not uncommon. It is characteristic of economic decision makers that profit maximization is the primary motive for making decisions, subject, of course, to the twin constraints of risk-taking and uncertainty.

The public decision makers attempt to make a concerted effort to improve the welfare of the City, although the indicators used to measure economic progress do not clearly reflect the intensity of this effort. During the early rounds, a typical game plan is to obtain additional revenue to upgrade the school system and municipal services, while at the same time attempting to redistribute the tax burden to fall more heavily on the business community and to a lesser extent on the work force. Lower income residents generally receive a tax break through the reduction of the sales tax on goods and services while the tax on auto owners is raised in the hope that the use of public transportation will increase.

The social decision makers are the citizens who live and work in the city. They are the voters and purchasers of goods and services needed to complete a real city. The social decision makers serve as the equalizing force to the government and economic systems. Their desire for leisure directly controls the amount of extra work, adult education, politics and recreation that they will participate in. Their voting power and environmental expectations directly influence the course of government. Social dissatisfaction can lead to boycotting businesses and industries as well as schools and municipal services. Their demands influence the type of housing and transportation they will accept which in turn affects all other parts of the municipal system. If city conditions are acceptable to the general population, inmigration occurs and city grows. Otherwise outmigration can send the city into bankruptcy if it continues for any duration of time. In short, commercial and government decisions ultimately must satisfy the general population if any city is to survive in the long run.

As in a real city, the public deficit looms as an obstacle in the path of all social reforms. So it is with the City game. The public administrators must face the debt problem and solve it before money can be allocated in

significant amounts to create the utopian society we all dream about. These administrative processes that implement social reforms require the integration of decision making through the various disciplines. As the game progresses, the conflict between the objectives of the public and private sectors becomes amplified. Both sectors begin to realize that they cannot perform their objectives independently and the learning process begins. As an example of this learning process, consider the micro-level analysis of shopping centers which are simulated by the "personal goods" and "personal service" industries. To perform this analysis, appraisals are required along with business and property analysis. Investment portfolio analysis is required to manage a variety of business enterprises and a portfolio of real estate resources. The constraints on the entrepreneur come from the public sector in terms of zoning restrictions, building permits, taxes, utilities, etc., which can prove very formidable. Hence, the public and private interests become interwoven and the Game provides a way of demonstrating decision-making in a society where there is a community of interest between the public and private sectors. The inefficiencies of independent decisions become expensive not only to the developers but to the community as a whole, so it becomes evident that it pays to have an improved analysis of the problems of managing the environment in order to achieve public objectives, whatever they may be.

The Director's Manual is designed to be a reference manual and cannot be read as a text book. This manual is one of a set comprised of a Director's Manual, Player's Manual, and Computer Operator's Manual. It is assumed that players will be given complete instructions in the rules for a particular game play by the Game Director who is experienced in running this particular game. Individual players will use only those portions of the manual that are applicable to their game role.

In the playing of the actual game, participants assume various roles in the public and private sectors as outlined in the players manual. A Game Director who is familiar with the Game in detail begins the Game with a classroom type lecture devoted to the discussion of the major decision roles in the City Model as well as the many printouts and reports that result from each role player's decision inputs. During this session, players are assigned a particular role (i.e., economic decision maker, mayor, school board member, etc.) and asked to read that portion of the Player's Manual dealing with his role. Using the manual as a technical guide, the players address themselves to the mechanics of coding forms and interpreting the computer printouts. It is at this time that the Director describes the preprogrammed city in the computer to the players. The Director has the option of choosing initial parameters such as economic growth rates, social conditions, production capacities, etc. to suit the particular objects of the players and thereby making the Game more flexible and susceptible to innovative approaches to urban problem solving. The Director can structure the role assignments to be directed at individuals who concentrate on single objectives such as heavy industry to multi-disciplinary task forces to consider urban problems within an interdisciplinary framework (e.g., a

task force on transportation policy might include a sociologist, political scientist, geographer, planner, engineer and an economist).

With initial roles established, the game begins. The Director generally starts the game by discussing possible objectives with each player or group of players along with the present or initial city conditions. For example, if the Director choosesto use the planning-programming-budgeting systems approach, each player or group of players must:

1. Define his general Goal wich is Output Oriented.

2. Identify objectives which indicate conditions or levels which must be obtained or maintained to successfully reach the designated Goal.

3. Draft Programs which are designed to achieve the standards set by the various objectives.

4. Evaluate the Programs to determine their effectiveness (in cost/benefit terms) as compared to alternative programs. Consider a political role in the urban system that is abstracted as follows:

   Political Goal: School Department
   Develop a school system comparable to the best in the nation, which will provide high quality, accessible and meaningful education experience to the City's population.

   Objective #1
   Maintain the pupil/teacher ratio at less than 21/1.

   Program #1
   Using the population growth projections, determine future student levels. Hire middle and high income teachers, at the optimum mix, to meet this demand.

   Program #2
   Redistrict school boundaries to better utilize existing City resources.

   Program #3
   Construct new schools or add to existing facilities as projected. (Specific round-by-round projections are used.)

   Objective #2
   Keep unmet demand for adult education at less than 10% of the total demand.

Program #1
Use the population growth projections, determine future student levels. Hire middle and high income teachers, at the optimum mix, to meet this demand.

It can be seen that the School Department has:

1. A definite goal (to be the best)
2. Identified meaningful standards of performance (student/teacher ratio of 21/1 and unmet demand for adults at 10% or less)
3. Determined approaches to achieve these standards (population projections, new construction, redistricting, etc.)

The previous example of the School Departments (see page 4) political goal could apply to most school systems in any City. We all want low student/teacher ratios and the best possible teachers for our children. New construction, better utilization of facilities and adult education programs with the most competent teachers available is certainly a laudable goal. The only obstacle to this utopian dream is that other government departments have their dreams and all departments compete for the lion's share of limited tax dollars. Besides education, the government sector (see page 52) must consider the problems of budgeting, taxation, assessment and bonding (see page 52 , highways (see page 55, fire and police protection (see page 162) planning and zoning (see page 56) , utilities and bus and rail transportation (see page 57) . Departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting Federal/State aid, changing levels of service.

In the game, all of the above roles are enacted by various players who strive to optimize their goals just as in the example of the school department. Collectively, the Government players work from a tax base that is continually being attacked by the tax payers as excessive and yet their very employment is incured by the elective process which, of course, is determined by the same tax payers who are continually demanding more services from the government. The source of government revenue is taxes which are levied on the population just as in a real city. Other players must assume roles in the city's economic sector to create employment for the population. The activities of the businessmen must include the operation of the industrial, commercial, and residential establishments which in turn require land purchases and sales, salary changes, maintenance level alterations, of commercial firms, acquisition of long and short term loans, and constructing, improving and demolishing businesses.

The commercial activities (see page 48) are subdivided within the game into Basic Industries, Construction Industries, Commercial Activities and Residences. The Basic Industry includes heavy and light industries and national services (including Standard SIC classes) which spend money

on many of the same items as the basic industry in order to maintain a level of service capacity. This service capacity is available to serve local customers. Finally, the residences, (single-family, townhouse, and high-rise) spend money on goods and services, utilities, taxes and earned income based on rent charged and the number and type of occupants residing in their housing units (see page 188).

The social sector (see page 51) is concerned with the income and expenditures of the population (see page 190), the dissatisfaction (see page 188) of the population in terms of housing, personal situation in the community, employment, and the amount of leisure time they can afford. Migration (see page 143) considers the movements of population in and out of the city. Finally, the social sector members vote (see page 274), Boycotts (see page 164), allocates their time for work and play (see page 116) and sets the dollar value on their time (see page 130).

The City model selected for game play may be a typical city or it may be the player's own city. The model employs a grid board (see Player's Manual) geographical map that can be loaded with data from any regional or metropolitan area. The map contains 625 parcels in which each parcel represents one square mile of land. Many of these land parcels are unowned at the beginning of play and those that are occupied are represented by a specific, representative land use. For instance if a square mile consists mainly of middle income residence, this parcel would be designated as such even though there could be a few commercial businesses within the square mile. The only requirement to assigning parcels is that the assignment typify the most representative land use. In a similar manner highways and roads are represented along the boundaries of the parcels. If you imagine a parcel as represented by a square, then a road is described as one or more sides of the square.

Once the representations are made, there remains the task of assigning numerical values and indexes to the many parts of the city's functions. For example, when various types of businesses are identified, they must be labeled with their dollar volume and prices for their products. Residences must be identified as to type and amount of rent paid. Voter registration and social dissatisfaction indexes must be established along with zoning classifications, cash availabilities, government expenditures, taxes road configurations and utilities and the election of city officials. These inputs along with the parcel classifications described the starting city. The files of this starting city are stored in the computer and can be altered by the game director to suit the player's needs (see Director's Manual). Changes in these files may affect the output of the computer but will have no bearing on how the computer calculates the output. The computer program directs the computer to act upon the data files in fixed relationships using the various data stored in the city file. In this way the computer can respond to updated file changes, act as an outside system, perform routine functions or processes that would be time consuming for the players and finally act as a bookkeeper (see Computer Operator's Manual).

At this point the game is ready to be played. Each player studies his printout generated from the starting city to evaluate his status as an individual and as a team member. Each team defines its specific problems, establishes objectives and develops strategies. Various groups will then gather for informal sessions for the purposes of bargaining, trade-offs and consummating deals. Eventually, each group arrives at final decisions for actions to be taken in that particular round of the game. These decisions are then entered into the computer by a special code and the model is ready to run. The computer then prints out a new series of data representing the change city.

In a typical game play the players generally behave in a predictable way with a minimum of player interaction early in the game. Players tend to feel that most interrelations should be avoided for the sake of secrecy. Most players use the guise of ignorance when talking to their peers early in the game and their contacts are limited to attempts at acquiring knowledge. As the player's command over the technical content increases, so does his awareness of the necessity for a properly functioning system. The player realizes that his economic aspirations will not be achieved unless his public counterpart can create a suitable "service-rich" environment in which he can operate. Typically, one or two players generally emerge quickly with an extensive grasp of the system and its technical content and assume the role of educator. In a fashion similar to the old ward politicians, the educators disperse favors (the patronage in the form of techical explanations), to gain the initial respect of his constituents. Needless to say, it is then a simple matter for the educator to insure his election to the mayoralty of the City.

As time passes, other players come to understand their role and the role of others and begin to realize that the mayor, although helping the city to function, often is insuring his own economic prominence at their expense. At this point, the era of the ward politician is inevitably (or generally) over and with this passing comes the emergence of the city manager. The political cooperation that grows from the new regime eventually leads to a full appreciation of the efforts of others and will open up higher levels of discussion concerning city-wide urban problems. Although the previous discussion concerns player behavior during game play, the influence of the gaming process has created a learning experience is one of the fundamental purposes of City Games and these experiences with the game can be transferred to the problems of the real city.

In most games, the Game Director's role diminishes as the play progresses and players become more familiar with the technical content of the game. Since bribes and boycotting are allowed along with collusion and other forms of special interest groups, a new aspect of the game appears, namely law and order. Players rapidly learn that disputes cannot be settled by opposing interest groups and the enforcement of agreements and compromises becomes almost impossible. Players demand legal systems and police departments and the local government is faced with new expenses to deal with. If these demands are met, the City managers must generate more income to meet these expenses and forego other spending plans. At this point, the hypothetical city is becoming

very real and very complicated to run. Even though it is a hypothetical city, players become emotionally involved and the intensity of their involvement permeates the playing area. Time is a constant enemy for the players just as in real life. Everyone wants everything at once and a typical game play allows the players about two to three hours per round to make their decisions. One round of the game is equivalent to one year of real time. If elections are required every two years, only two rounds are played before new elections. If the newly elected officials fail to honor prior commitments by their predecessors, well, the best laid plans .... !

It is within this framework that the City IV manuals are written. There are three manuals for City IV; a Director's Manual, a Players' Manual, and an Operator's Manual. The Director's Manual is designed to explain the technical content of the computer program including term definitions, programming change procedure and the numerous technical details associated with the game. It is assumed that the Game Director has been taught the gaming operations prior to assuming the Director's role and will use the manual as his primary reference source rather than a set of instructions for running the game. The manual further assumes that a Director has had training in Fortran programming and understands formating and coding in addition to being knowledgeable about urban problems. The Director designs the initial city conditions for a typical city and specific computer commands for altering these conditions.

The Players' Manual is also designed to be a reference manual and not a text book. The complexity of the game requires extensive reading on the players' part prior to the start of a game or selective reference material which is coordinated with the Director's introductory lectures and possibly monitors who are trained in the gaming procedures and will coach the individual players when required. This latter approach has proven to be the most effective method of training players. If past games are indicative, individuals seem to learn their roles much faster when coached by a monitor during actual playing conditions as opposed to concentrated reading and memorizing prior to the start of a game. It is not presumed that players have prior knowledge of this game or even simulation in general. The game is designed so players do not need to know computer programming or how to operate the computer. These functions lie with the Director and the Computer operator.

The Operator's Manual is written for an IBM 360 and presumes that the operator knows how to cold start the computer and mount the tapes. This manual explains the relationship between the programming data, the taped program and the operation of the computer. Test sequences are given along with a detailed explanation of switch control and error message. It is not required for the operator to understand the Director's or Players' role but only to be knowledgeable in operating the computer.

In general, the game should be played with at least 50 players utilizing a large room where players can move freely about. Computer printouts are usually taped on walls for easy access by all players. An optional display usually taped on walls for easy access by all players. An optional display would be a gaming board for visual display of the city. The board is marked off in grids to conform to the City map and plastic playing pieces are used to represent the various types of buildings. Colored tape is used to mark off highways and boundaries. Human interest is added if one player agrees to become the Big City News Editor. The idea is to subtly report on the good and bad features of the game play in a humorous way. The Game Director reports the results of each round to the news editor who proceeds to write this paper and distribute it before the players learn the results of the round. The detailed computer outputs are then distributed to the players so that they may learn how well their particular game plan went. In toher words, the paper presents the overview and the computer reports on the specifics. This method allows the Game Director to concentrate his time on selected areas rather than all areas at the end of each round.

As the director of a play of the City Model, you select the starting city configuration used by the participants, change a number of conditions in the city before the start of play, and have a continual affect on the play through the use of the many director options.

The figure on the next page shows your position in relation to the computer operations, the simulated city area, and the participants. As director, your first choice (once you have determined the overall objectives of using the City Model and assembled a group of participants) would be to select one of the five initial starting positions. Each of the starting positions has the city's resources distributed among the sector teams and specified cash balances in the accounts of the economic and government teams. The director may alter many of these initial starting characteristics by making inputs to the computer before the participants begin play. The director can continue to influence the play throughout its duration by making further inputs, acting as the Outside System, and distributing the computer output in various ways. The director can also affect the play tremendously by how he forms his teams and what responsibilities he assigns to groups of players or to individuals.

The director, then, may be as active or passive as he desires. Operating City Model does not require the director to influence the play or make inputs, but the model does allow him to control play if he wishes to.

This Manual describes what the City Model director needs to know in order to operate the model, influence play, and answer participants' questions that are not fully covered in the Players' Manual. The director, of course, should be thoroughly familiar with the Players' Manual.

This Manual focuses on four major points:

1. Responsibilities of the director before the start of a play (including choice of city, formation of teams, instruction, and motivation). (Chapter II)

2. Operating a round of play (including distribution of output, length of round, motivating play, making decisions, and inputting decisions). (Chapter III, Appendices A, B, C, D, E, F)

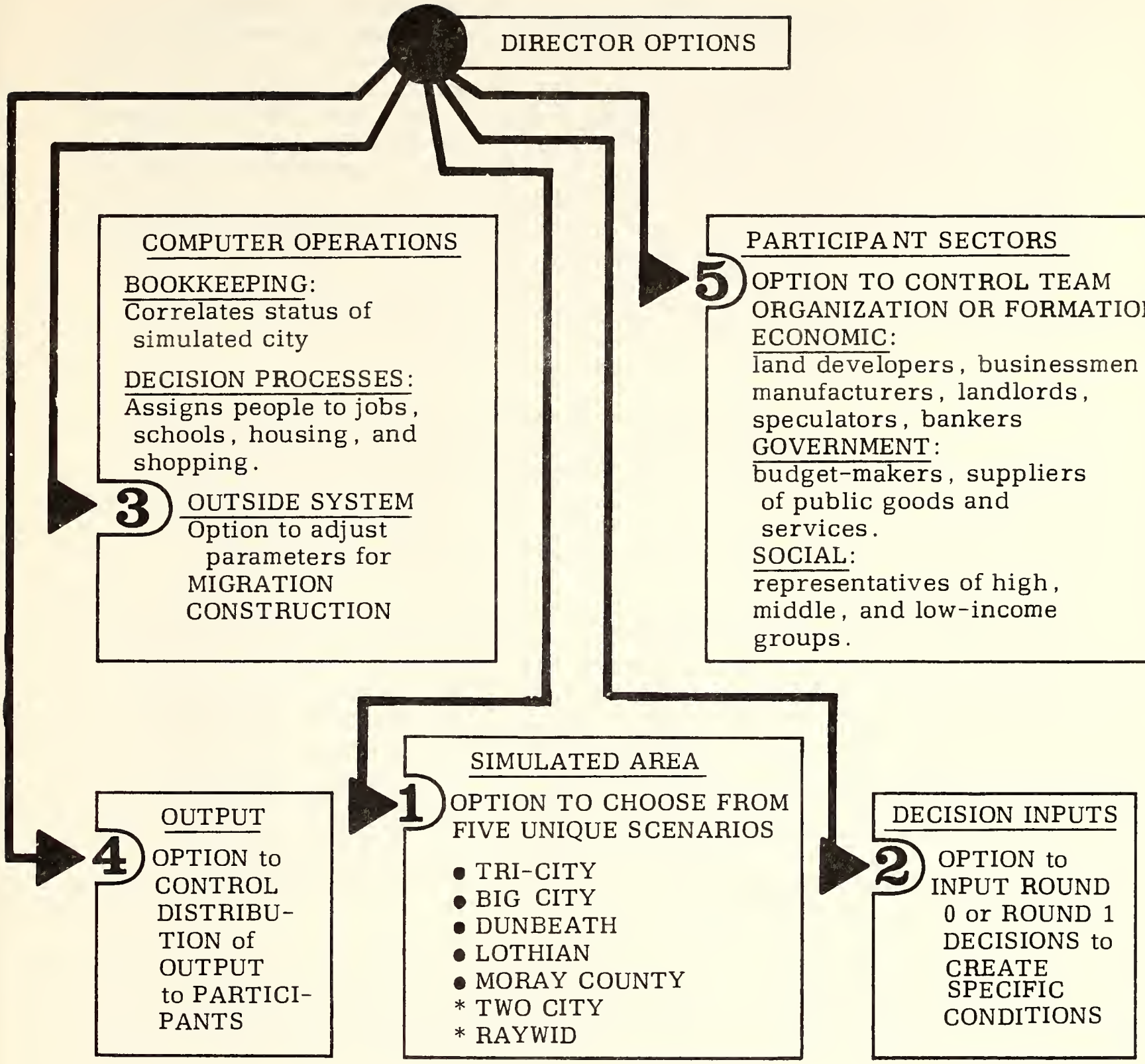
3. Complementary exercises and materials (including elections, town meetings, mass media, legal system, special projects and outside readings). (Appendices H, I, K)

4. Explanation of some of the major computer operations (including employment and commercial processes, migration outside system, and many others). (Appendix G)

As you will notice, this manual is organized with only four chapters but fifteen appendices. The first three chapters contain unified and sequential information. The fourth chapter, the appendices, contain complementary information on different aspects of play and do not sequentially follow the first three chapters.

Reading the Players' Manual and the three chapters of this manual will give you sufficient knowledge to run an adequate play of City Model. By also reading the appendices, you will be able to direct a play that will not only be more interesting but be more rewarding for the participants and yourself as well.

You should understand the use of the term "round" and how rounds are numbered. The director/operator must deal with two rounds; the player's output is known as a "round," and the data base stored in either a tape file, or as it remains in the computer system, is a "round" of data. Players make decisions from a data base numbered the same as the round of output with which they are playing.




- These are cities in which the health index is not developed from water pollution.

* The effect of water pollution on the health index is included.

Thus, care should be taken in discussing "rounds" with the players, computer installation staff, or the operator to avoid misunderstandings.

In addition to the normal problems of the City, the Gaming Model can be used for more sophisticated analysis. The economic base can be investigated to determine the causes of a changing growth rate along with identifying the components of the economic base. Business cycles can be explored since they are dependent upon sales of goods and services outside the local economy and must be supplemented by an analysis of the condition of the National economy. This provides a useful yardstick for measuring economic performance. By charting the prices for basic industry output, the return on investments and the interest rate on loans and bonds, the players can determine which phase of the business cycle they are in which in turn, would partially explain capital investment attitudes.

Other basic studies important to public and private decision makers concern the tracing of population growth and projecting future levels. Trends in employment (total), employment distribution by industry, unemployment rates and income distribution are available and in a usable form in the City's output. Here again a PPS format would guide the player in assembling the pertinent facts and disregard peripheral information.

Housing market analysis becomes important in any geographic area where dwelling units are in competition with one another as alternatives for the users of housing. This problem incorporates many of the previously mentioned types of analysis: economic base, employment trends, income distribution and population analysis along with the additional component of housing stock or inventory. The magnitude of the total housing stock in terms of dwelling units, reflecting changes over time, is one of the most significant indicators of city growth coupled with a changing distribution of the inventory by structural type. Equipped with this knowledge plus an awareness of vacancy rates, rents, property values and financial market conditions, the private developer could make a rational decision as to the advisability of a housing investment.

Appraisal theory can be utilized to aid prospective purchasers and sellers as to the market value of particular parcels of land. The data needed to apply to the cost, income and marketing approaches to appraisal theory is available on the various output sheets supplied by the game.

The problems of social reform can be explored in terms of social dissatisfaction and leisure time demands. Social players determine the amount of money they will pay for transportation and a variety of experiments in public transportation can be tried. Since the social players are the voters, political boundaries and voter redistricting are viable possibilities within the gaming framework. The problems of slum clearance and urban renewal in general are an integral part of game play and many ideas can be tested utilizing the game.

The previously listed examples are sample types of game play Each time a game is played, it is structured to meet the needs of the particular group of players. Players can be richly rewarded with a learning experience that can be applied to real city problems. The variety and combinations of gaming situations are endless, as they are in a real city. The players themselves insure that no two games are identical because individual players are not identical. In this sense, City IV is a teaching game that portrays the abilities of the particular players to manage a city.

## II. BEGINNING OF PLAY

### A. Choice of City

The Game Director may select one of seven initial starting configurations representing rural and urban regions of varying sizes. In determining what city to play, the Director should consider the factors summarized in the tables on pages 15, 17 and 18. In addition, scenarios for each city are included as Appendix I.

In one of the optional cities, the City Model focuses on a micro-view of an urban area by reducing the level of aggregation. In this option, Lothian, the population is reduced ten times so that each population unit equals 50 persons (instead of 500) and each unit of linear measure equals one-third of a mile (instead of a mile). Hence, in four of the cities, each parcel is equivalent to one square mile of land; and in Lothian each parcel is equivalent to one-ninth of a square mile of land. The reduced scale values are reflected in the second set of master sheets accompanying the Players' Manual. This set should only be used when playing Lothian.

While the small scale enables a player to better relate everyday experience and environment to the factors in the model, that focus makes it impossible to consider things covering a large geographic area. Players interested in developing an integrated multi-modal transportation network would be frustrated in attempting its implementation in a small town, small scale environment. A metropolitan area represented on the large scale is a better area in which to test such a system. One potential drawback of the large scale to the players, however, is that this scale sometimes presents difficulties in conceptually dealing with activities which represent sizeable aggregations.

Scale is tied directly to the starting configuration. As Lothian can only be played small scale, every round of play is at that scale. Consequently, playing a particular scale level can only be accomplished by playing a particular city.

Besides the figures in the table on page 15, the Director has a virtually unlimited source of starting configurations. By making input decisions on the Round 0 (pre-starting round)* data base, the Director may create a virtually infinite number of starting positions. The following table suggests ways that the initial starting base can be restructured by a combination of Director options and what are normally player decisions.

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*In the case of population changes, the immigration options are first exercised during the EDIT program which precedes round 2 (i.e., on the Round 1 base).

BASIC CHARACTERISTICS

| CITY NAME | BIG CITY | TRICITY | DUNBEATH | LOTHIAN | MORAY COUNTY |
|---|---|---|---|---|---|
| POPULATION | 1,548,500 | 601,000 | 275,500 | 50,000 | 11,500 |
| POPULATION SCALE | PL = 500 | PL = 500 | PL = 500 | PL = 500 | PL = 500 |
| TOTAL MARKET VALUE OF PRIVATE DEVELOPMENTS (in millions of $) | 9,286 | 2,504 | 90 | 14 | 9 |
| PUBLIC DEBT (in millions of $) | 336 | 355 | 39 | 13 | 8 |
| NUMBER OF DEVELOPED PARCELS | 245 | 136 | 59 | 173 | 19 |
| CPU TIME | 17 minutes | 5 minutes | 3 minutes | 6 minutes | 2 minutes |
| PAGES OF OUTPUT | 260 | 280 | 220 | 240 | 160 |

FIXED MODULES

| | | | | | |
|---|---|---|---|---|---|
| JURISDICTION | 2 | 3 | 1 | 1 | 1* |
| STARTING ECONOMIC TEAMS | 10 | 10 | 7 | 10 | 4 |
| MAXIMUM ECONOMIC TEAMS | 10 | 10 | 7 | 10 | 10 |
| SOCIAL TEAMS | 10 | 10 | 7 | 10 | 10 |

USABLE MODULES (Starting)

| | | | | | |
|---|---|---|---|---|---|
| RAIL | Yes | Yes | No | No | No |
| BUS | Yes | Yes | Yes | Yes | No |
| PREEMPT LAND | Yes | Yes | No | Yes | No |
| PUBLIC INSTITUTIONAL LAND | No | Yes | Yes | No | No |
| LOCAL CONSTRUCTION INDUSTRY | Yes | Yes | Yes | Yes | No |
| ASSESSMENT | Yes | Yes | Yes | Yes | Yes |

*The director has control over two additional jurisdictions, each of which is composed of 4 parcels (sq. mi.)

The first five configurations of page 15 are taken from the old data bases of CITY II and the next two on page 15 have been developed so that the effect of water pollution on public health could be studied in addition to all that could be examined in the first five configurations.

The next Figure on page 17 shows a few statistics for the local systems of these two basic starting configurations: TWO CITY and RAYWID CITY. The starting configuration called TWO CITY is a completely hypothetical regional area, while RAYWID CITY is fashioned after the actual Cleveland-Akron regional area (which contains the Cuyahoga River Basin).

Note that the population sizes are quite different with RAYWID having about nine times the number of people. RAYWID CITY also has a higher concentration of low income residents, a worse quality of life index, a lower average education level, a higher unemployment rate, and more overcrowded housing. In RAYWID CITY a larger percentage of the school population is enrolled in public schools and the student teacher ratio is slightly better than that for TWO CITY. The river system is more extensive in RAYWID CITY and there are many more polluters in each of the cateogries of polluters.

Another set of considerations from the director's point-of-view when selecting which starting configuration to use, are the operational differences among different starting configurations, i.e. the number of teams and the running time on the computer. Figure 3 shows some operational characteristics for TWO CITY and RAYWID CITY.

Note that there is provision for many more teams in RAYWID CITY. Of course, the Director may give the control of the assets of serveral teams to a single individual or group of individuals, and there is no requirement that the number of players be as large as the number of starting configuration teams.

LOCAL SYSTEM COMPARISIONS OF TWO CITY AND RAYWID CITY

| | TWO CITY | RAYWID CITY |
|---|---|---|
| Land Area (square miles) | 3,906 | 2,519 |
| Parcels | 625 | 403 |
| Number of Political Jurisdictions | 2 | 3 |
| Total Population | 275,500 | 2,508,000 |
| Percent Distribution by Class | | |
| HIGH | 37 | 31 |
| MIDDLE | 36 | 34 |
| LOW | 27 | 35 |
| Percent of Workers Earning Under $5,000 | 33 | 36 |
| Total Assessed Value (millions) | $12,733 | $26,296 |
| Average Quality of Life Index | 69 | 117 |
| Average Education Level | 59 | 49 |
| Unemployment Rate | 7.5% | 13.7% |
| Workers Receiving Unemployment | 12,800 | 127,240 |
| Student-Teacher Ratio | 7 | 6 |
| Percent of Students Enrolled in Private School | 30 | 13 |
| Housing Vacancy Rate | 4 | -1 |
| Features of the Water Component | | |
| Miles of River | 87.5 | 130 |
| Number of Rivers | 3 | 7 |
| Types of Polluters | | |
| Surface Water Industries | 4 | 14 |
| Municipal Outflow Points | 2 | 11 |
| Farms Contributing to Runoff | 3 | 8 |
| Total Population (thousands) | 276 | 2,508 |

OPERATIONAL COMPARISIONS OF TWO CITY AND RAYWID CITY

| | TWO CITY | RAYWID CITY |
|---|---|---|
| Number of Economic Teams | 7 | 23 |
| Basic Industry Only Teams | 2 | 4 |
| Commercial Only Teams | 0 | 3 |
| Residences Only Teams | 2 | 5 |
| Mixed Teams | 3 | 0 |
| Miscellaneous Teams | 0 | 12 |
| Number of Social Teans | 7 | 9 |
| High Income Only Teams | 2 | 3 |
| Middle Income Only Teams | 2 | 3 |
| Low Income Only Teams | 1 | 3 |
| Mixed Teams | 2 | 0 |
| Number of Separate Government Jurisdiction | 2 | 3 |
| Number of Government Teams | 14 | 21 |
| Chairman | 2 | 3 |
| Assessment | 2 | 3 |
| Utility Department (Water Office) | 2 | 3 |
| Municipal Services | 2 | 3 |
| Planning and Zoning | 2 | 3 |
| Schools | 2 | 3 |
| Highways | 2 | 3 |
| Bus | 0 | 0 |
| Rapid Rail | 0 | 0 |
| Approximate Number of Pages of Computer Printout | 290 | 350 |
| CPU Running Time | | |
| 360/40 | 60 | 200 |
| 370/165 | 5 | 10 |

| Decision Type and/or Direcotr Option for Pre-Round 1 Adjustments | Sector Directly Affected | Basic Results of Action |
|---|---|---|
| Vary number of in-migrants[1/] | Social | Population by class increased or stablized |
| Choose construction facility Local Construction Industry | Economic, Government | Round lag for completion of construction projects (each takes one year to build). Player operation of CI including: negotiation of contracts; local employment, etc. Local CI is choice unless director specifies otherwise. |
| Construction, Demolition[2/] | Economic, Government | Developed area of city is changed. |
| Cash Transfer | Economic | Round 1 cash balance can be altered. More cash usually leads to more developments. |
| Cash Transfer | Government | Operating subsidies provided or great budgetary pressure applied to departments. |
| Public Land (Preempt) | Economic | Land made either undevelopable or open for developments if land was previously undevelopable. |
| Decisions normally under player control | Social Economic, Government | Alter use indices (change employment); wage and/or price structure changed; improve or hamper public services, etc. |

[1/] Since the migration routine is first operated at the beginning of round 2, this director option may first be exercised during EDIT before round 2.

[2/] Decision-maker for whom construction and/or demolition is being contracted must have sufficient funds in his account. Note that in none of the starting configurations does any construction industry have outstanding contracts (including the Outside). Thus, without director inputs (Round 1 EDIT) no construction industry will receive income, nor will any new developments appear in Round 2 in the case of YESCI or in Round 1 in the case of NOCI.

An explanation of the public land use and construction modules and what these options imply in terms of play and model structure is given in Chapter II. More fully illustrated uses of normal player inputs to the modules listed above are included in Chapter II's discussion of Director options.

Since construction strongly affects the economic and demographic structure of the simulated area, the players should be made aware of the start of play which version of this routine is being employed. The potential consequences of their using it should be highlighted also. For example, choosing the option of whether, once contracted for, construction is performed immediately in a round or with a round lag makes considerable difference to an economic decision-maker. Moreover, since construction causes rapid expansion, it pressures the government to react more quickly to economic development.

## B. Formation of Teams

A list of economic, social and government teams and their major characteristics is given as part of the description of each starting configuration. The director may desire to modify the number of teams, have a group of participants play more than one team simultaneously, or change the composition of a team.

An increase or decrease in the number of social teams can be accomplished simply by combining or separating the output that presently is available as in the first example of economic teams. Since social teams do not have any output that is comparable to the cost statement and land summary statement in the economic sector, social output can be combined or separated with greater freedom. The social output is already separated by class and by jurisdiction, thereby providing a straightforward basis for further division among participants.

### 1. Altering the Number of Teams

For example, let us assume that there are seven economic teams, but that the Director wants only four. The reduction in the number of teams may be accomplished by either allocating the seven economic sets of output among four groups or players (this is the least complicated method because no input need by made to the computer) or by dividing the assets of the last three teams among the other four teams (this requires a set of input cards that indicate the purchase at zero price of the latter three teams' assets by the former four teams).*

Another example, let us assume that there are seven economic teams and the director wants ten. This can only be accomplished if the starting configuration permits additional economic teams, each of which has no assets or liabilities. Through inputs on the Round 0 base the zero balance teams may be given only case, or they may be given land and developments from each of the four original teams.

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*In this latter case no liabilities can be transferred.

An increase or decrease in the number of social teams can be accomplished simply by combining or separating the output that presently is available as in the first example or economic teams. Since social teams do not have any output that is comparable to the cost statement and land summary statement in the economic sector, social output can be combined or separated with greater freedom. The social output is already separated by class and jurisdiction, thereby providing a straightforward basis for further division among participants.

2. Making Teams Operate Across Sectors

The Director may also wish to have a group of participants play several sector roles at the same time. For example, he might give a three person decision group the economic output for Team A, the social output for Team AA, and the government output for the School Department and ask the group to play all three sectors simultaneously.

An alternative would be to have decision groups act as both economic and social teams, with individuals elected and appointed to the government teams. This would not only give every player an identification with an economic base and social interest group, but also allows him to perform as an individual in the Government Sector.

3. Changing the Resources of a Team

The Director may wish to alter the resources of an economic or government team. The extent to which the Director may do this might be as little as changing the cash holdings or add debts, or as extensive as changing all the economic holdings so that each economic team has only one type of development. In this latter change, one team could control all the HI, another team all of the BG and BS, and another team all the RA housing of a certain quality index or in a certain area of the city. Conversely, the Director could change all of the economic holdings to represent geographical interests rather than functional specialization.

C. Distributing General Output

The Director can be selective in how he distributes the general computer output. In order to introduce the participants gradually to the complexity of play, the Director might choose not to explain and post all of the general output. Such information as the employment diagnostics and the commercial diagnostics might be withheld until the players request such information or until such time as the Director feels that this output should be introduced.

Moreover, the Director may choose to permanently withhold some of the output and simply "sell" information from the output to players who pay the price designated by the Director. This payment can be deducted from the team by inputting a cash transfer to the outside. (See page 102)

He could do this because the information provided by some of the general output is much more than is typically available in the real world. Thus, the team payments for information could represent special surveys and research studies.

Likewise, the Director may wish to withhold some roles from participant involvement until such time as he feels appropriate. For example, Bud Department, Rapid Rail Department, and Assessment Department may all be left to run automatically until the Director chooses to hand the decision-making power over to the participants.

## III. RUNNING THE ROUND

### A. Prefatory Notes

In order to distinguish between the technical round and the gameroom round, it is essential to provide both background information on the sequence of the computer operations and illustrations of the actual play sessions which the Director conducts. The technical round (A) involves computer processing of the players' decisions and the subsequent which traces a year's activity, while the gameroom round (B) entails the players interacting in making decisions. On the latter, this chapter will offer several suggestions toward instituting a decision-making process, and expand on the Director's options listed in Chapter II.

The importance of how teams are formed and the gameroom is organized, policies which precede the first round of decision-making should be reemphasized here. These procedures, highlighted in the second chapter, greatly influence what direction the gameroom round will take. The remarks in the second chapter complement future discussions of the play.

### B. The Computer Round*

In a typical play of City Model the computer round begins with the EDIT program processing player inputs. This program rejects any improper or invalid decisions and records the changes specified by the correct decisions. Appendix G gives a detailed explanation of the error messages caused by improper or invalid decisions. After Director and Player inputs have been processed, the program and data base are ready for the execution of the simulation.

The routines composing the simulation (technically known as City IV) and what each routine produces are listed below in the sequence in which they are processed.** The right hand column is a brief description of what each routine does. Routines marked by an (*) are further described in Appendix G. Furthermore, the computer processes fully each routine only (1) once and (2) in the order listed below. Inputs for each routine are only processed during a routine's "turn". Note that each of these operations changes the data base encountered by routines executed later in the sequence. For example, the employment allocator (5 and 6) generates employment figures which the commercial allocator (13) uses in order to determine the effective capacity (the actual level of operation) of commercial establishments.

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*For a technical discussion of the programs and how to execute them, refer to the Operator's Manual.

**The names used here are not the actual program names, but rather names used to facilitate the readers' understanding. A more precise list of routines are presented with description at the end of Appendix G.

| | NAME OF ROUTINE | RESULTS OF OPERATION |
|---|---|---|
| *(1) | MIGRATION | Calculates population unit dissatisfaction and moves people into, out of, and among residences in the board area. Diagnostics are printed. |
| *(2) | ASSESSMENT | Assesses all privately owned land and buildings. Prints series of six maps and assessment department's output. |
| (3) | DEPRECIATION | Depreciates all developments, except roads, as a function of the development type (annual depreciation rate). MS use index, and usage. |
| (4) | MAPS | Prints the five updated status maps reflecting the new round's changes before maintenance. |
| (5) | FULL-TIME EMPLOYMENT | Assigns workers to jobs and to the transportation mode and route from home to work. Prints diagnostics in "per worker" terms. |
| (6) | PART-TIME | Assigns Pl part-time work units to jobs on same basis as full-time. Prints diagnostics. |
| *(7) | SCHOOL ALLOCATOR | Assigns students (children) to schools in their district or to private school. Prints "School Map." |
| *(8) | ADULT EDUCATION | Assigns Pl (PM and PL adult) time units to public education on basis of time allocation and available capacity (by jurisdiction). |
| (9) | MUNICIPAL SERVICES | Calculates total usage (units drained) for each MS plant. |
| (10) | CONSTRUCTION INDUSTRY ACCOUNTING | Determines contract status of each project (either "pending" or "deferred"). |
| *(11) | FINISH TIME ALLOCATION | Allocates time units remaining after time consumed for trip to work to part-time work, adult education, politics and recreation (up to player-specified amounts). |
| (12) | PARK USAGE | Assigns Pl's to parkland. |

| NAME OF ROUTINE | | RESULTS OF OPERATION |
|---|---|---|
| *(13) | COMMERCIAL ALLOCATION | Assigns customers to commercial establishments, renovates all developments except BG and BS, depreciates and renovates roads. Prints commercial diagnostics. |
| (14) | TERMINAL ALLOCATION | Assigns all HI, LI and BG to terminals. Prints diagnostics map. |
| (15) | SOCIAL AND ECONOMIC OUTPUT | Calculates income and expenditures for all PI's, businesses, and economic teams. Prints this information plus the other characteristics of each social and economic team. |
| (16) | HIGHWAY OUTPUT | Calculates Highway Department income and expenditures, floats current bonds if necessary, and prints map. |
| (17) | HIGHWAY MAP | Prints a map of the road network. |
| *(18) | BUS COMPANY OUTPUT | Prints bus company status. |
| *(19) | BUS AND RAIL ROUTE MAP | Prints four maps of bus and rail networks. |
| *(20) | RAIL COMPANY OUTPUT | Prints rail company status. |
| (21) | SCHOOL OUTPUT | Prints school system status, adult and children, by jurisdiction. |
| (22) | PUBLIC OUTPUT | Prints MS map and status, UT map and status, Planning and Zoning maps (3) and status, and the Chairman's report. Each status report is by jurisdiction. |
| (23) | SUMMARY OUTPUT | Provides summary statistics of board area activity plus a diagnosis of National Economy (outside) conditions and transactions. |
| (24) | ACTUALIZE BUILD | Enables pending construction projects to appear completed at start of next round. |

C. The Players' Round

In a round or play participants analyze their output, maintain game-room communications, develop short and long term objectives, and submit their formal decisions. While the City Model Players' Manual supplies the information and basic mechanics that the players require to complete the first task, the Director commands a large amount of influence over the other three phases of the decision-making process.

There is little danger of rigidity in starting a play within a certain framework. City Model is flexible enough to accommodate any degree of restructuring from one round to the next. On the other hand, a laissez-faire approach to directing the play may be appropriate and clearly possible. Caution should be exercised, however, in allowing first-time players to begin in this fashion, as the absence of all framework may lead to a disjointed game play.

Since any game objective implies a certain team formation, communications network and strategy formulation, the Director should devote some time to organizing these areas. Team formation was discussed in Chapter II. The communications network has its foundation in the logistics of the play (where the teams are located and their proximity to other sectors, etc.) and in how the output is distributed (see Chapter I also). Additional means of communication include those provided by a mass media, governmental regulatory agencies, and ad hoc "citizens" committees. These and other suggestions are discussed more thoroughly in Appendix H. The final areas of Director organization are discussed in the remainder of this chapter.

1. Game Formats and Strategy Formulation*

Strategy formulation, which encompasses the total environment of the decision-making process, is an area where the Director can best instruct and "guide" the players. While the developers of City Model encourages the Director to exhibit as much creativity and imagination in terms of game motivation as possible, this manual provides suggestions to assist the Director in producing a meaningful play.

Given any game format, a limited subset of strategy formulations is defined. Therefore, selection of a game format implies player assignment to roles which have recognizable objectives. Thus, the Director should be wary of restrictions to flexibility which a particular format prescribes. On the other hand, the specification of a format may enable the participants to involve themselves in the game, a situation which may not have been obtained without early direction. Moreover, once involvement occurs new formats and strategies will undoubtedly evolve.

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*Appendix H contains discussion of the following formats and means of game-room communication: mass media; federal/state aid controller; data and information consultant; alternative forms of government; legal system; insurgency; holding corporations; building inspector; citizen commissions; and citizens interest groups.

Seven format suggestions are listed below. None are developed fully here, and there are no detailed examples of the manner in which they would be implemented. Nevertheless, the brief descriptions should enable the Director to conceptualize the structures implied in the formats. This area will become much more comprehensible to the Director when he acquires a working knowledge of the model and its processes.

ONE. Develop an analogy between the dynamics of the game and real world problems of decision-making.

Once the participants comprehend the functions of the decision-making teams, an effort would be made to interpret their output in terms of real-life situations. Utility units become kilowatt-hours; adult education becomes vocational training, on-the-job training, and the pursuit of college degrees.

The players should consider their very localized interests and competitive relationships. Finally, each problem can be identified as though it were a real world phenomenon which can only be acted upon through real world means. For example, poor police service results in more crime. What solutions are available: hire more police, provide more facilities, etc.?

TWO. Deal with real world issues as though unrestricted by the components of the game. (The converse of One.)

Insure that the players have little or no prior knowledge of the game. Let them formulate the issues and problems of urban systems, particularly as they relate to the individual participant: should public schools be eliminated; should neighborhoods have autonomy over school boards; what good is a metropolitan government; are corporations economically feasible?

Isolate each issue and illustrate through a segmented play of the game how such a program or situation could be implemented; identify the impediments to implementation, and the simulated consequences of the action.

For example, it is posited that a natural (or man-made) disaster of catastrophic proportions would completely disable a city, precluding any reconstruction or even survival. The Director could put in numerous demolitions and decreases in levels of hiring capacities for departments and then run several "years" of simulation. The game's activity following such an event would present a basis for provocative debate around such questions as "what would have happened if ...?" This debate in turn, would generate more demonstrations and more real world involvement.

THREE. Operate all functions to achieve goals called for in a Master Plan

Communities often develop Master Plans to guide future growth. While the players would be required to participate completely in the decision-making if this format is used, they will soon become aware of how inflexible and

limited their options are. Each potential decision from all sectors would be subjected to careful scrutiny to insure that nothing would cause deviation from the path intended to lead to a common objective.

Analysis of the decisions, the development of the plans, and evaluation of the psychological effect of narrowing player motivations are three fertile areas for growth of ideas and interpretations.

FOUR. Restrict the evaluation techniques of each decision-maker to those of cost-benefit analysis.

For some decision-makers, this specification requires that they translate intangibles into dollars-and-cents terms. The assumptions and philosophies they use in making this first step of the total analysis merit classroom investigation. Note that applying time-dollar-value decisions to the social sector is a microcosm of this approach.

Under this format the participants must thoroughly understand their roles and the game components which affect their activities, population units, and the like. Subsequently, each alternative decision can be processed in a fixed pattern: any possible move is sorted into a cell with all other actions having related effects; the combined cost (such as those from increased prices of personal goods if a shopping boycott is begun, or decreased current expenditures from not improving the municipal services use index) must be compared to both projected immediate benefits such as loss of revenue in economic sector due to lower maintenance expenditures caused in part from the second action stated above, and long-term effects (again for the second case, outmigration of populations units).

The manner in which this format is described implies that most decision-making is done by making a cost-benefit analysis. This is not necessarily the lesson or intention of this format, as strict adherence to this approach removes intuitive responses and probably encourages a strictly ordered play. Obviously there are drawbacks as well as benefits to this format if such a result is obtained.

The following two examples suggest game formats which are actually sub-formats of a play. Thus, either one could be incorporated while a larger theory is applied to the whole play.

FIVE. Operate the government departments autonomously.

Remove the larger bureaucratic structure of the government by making each department responsible only to itself. The departmental decision-makers could be either appointed by the game Director or elected individually by the social and/or the economic sector. In either circumstance, intense self-interests and competitive instincts could develop for each department and even for each jurisdiction. The Director should control all departmental financing.

Some of the consequences of this format include the alliances between a social or an economic team and a particular department.

SIX. Organize the economic teams so that they act as a single unit.

In effect, the economic sector becomes one team. This format, where the economic sector is an oligopoly, could easily evolve to many illustrations of other nations; political and economic structures. Regardless of whether or not lessons on political economy are important to the Director, perpetual confrontation between sectors is obviated. The consequences of these confrontations should provide several experiences in the machinations of power.

A variation of this economic format is the collusion of social teams into a strong civic organization and/or political power base. Both sectors would then be vying for control of the government sector which holds monetary and other rewards for the controller.

SEVEN. Encourage a zero population growth policy

By exercising the inmigration option, the Director can effectively stabilize the population. This would allow the players to adopt a zero population growth policy and attempt to carry it out. The players might be convinced that the best policy they can undertake as a group is to increase the satisfaction of the people living in the local system. Thus, all attention could be placed on the quality of decisions given an overall population level.

To carry out such a policy, the economic incentives required, the population regulations needed, the economic growth (quantity) foregone, and the public services levels required would be illustrated. In an environment with a stable population, the transportation decisions and land use decisions would be linked together to provide a played-determined optimal locational pattern within the constraints provided by the initial starting conditions and the available capital.

The players would be made aware of the difficulties involved in maintaining a standard of living in a stagnant economy. The outside system would take on a different meaning since most of the players' investments would have to be made in conservative and speculative outside investments. The development of a favorable balance of trade between the local and outside system would become crucial. Outmigration would have to be guarded against.

In summary, the players would be faced with a unique public and private policy challenge that has not been afforded to many real life decision-makers on a voluntary basis.

Even after a format is fitted to a play and the players are cognizant of the objectives of the game, some may still encounter difficulty in organizing their individual actions. While the circumstances of player failure to operate in a decision-making context is unlikely, a particular strategy formulation technique is included to aid the Director if such a barrier is encountered.

The strategy is simply a sequence of actions to be taken by an individual player: identify a problem; probe it with questions; search the output for answers; develop alternative decisions; implement some of them; and re-analyze the problem on the basis of those decisions. The particular context from which the following examples are drawn is a format equivalent to the first one above and to the standard formation of teams into separate sectors, with separate control and responsibilities within each sector.

Players should be able to identify dozens of problem areas which could be analyzed in a similar fashion. Consequently, the Director may wish to sketch a master form from which the players could proceed to develop decisions as a learning exercise.

2. Director Interaction with the Players' Input Procedure

The Director should emphasize the need for players to carefully follow the steps required for a valid input. Two types of errors are most common. The first involves coding errors, such as the improper scaling of numbers. Players should be reminded to double-check their coding forms before submitting them for the EDIT program. The second type usually results from players not making sure that the requirements necessary for the effectuation of certain types of decisions do in fact prevail.

Two appendices are included in this manual to help facilitate players identifying the steps that they must take. The appendices merely complement the decision-making outline found in the Players' Manual. Appendix A contains thumbnail checklists of the requisite information for each player decision. Appendix B represents a visual approach to explanation of the system's sectors in the form of flow charts. Should the players encounter difficulty in their efforts to complete the basic decisions, the Director may illustrate a sample procedure, as presented in either Appendix A or Appendix B.

Besides preparing his own inputs described in the following section, the Director should oversee the players' input procedure in order to limit the number of mistakes they make. Appendix C provides an aid to check for proper formatting. The first section of Appendix C describes the general input format, lists all of the possible decisions and notes which decision-making sector has purview over that decisions. The second section gives the Director a summary of his decisions and the input explanation form for both scales. This section has been modeled after the input explanation chapter of the Players' Manual. Refer to the Players' Manual for instructions on how to use the input decision form.

# DECISION-MAKING SEQUENCE: economic sector

**1** IDENTIFY the PROBLEM

Economic decision-maker B discovers that his BS1 at 9832 lost money after receiving earnings at a ten percent rate of return in a prior round.

**2** RAISE QUESTIONS

- What is the competition?
  - Are there locational disadvantages?
  - Is the price competitive?
- Is there enough demand to support all the BS establishments?
  - Are there boycotts against the BS at 9832?
- Was the supply (effective capacity) reduced?
  - Is the value ratio adequate?
  - Did the BS receive a full complement of employees?
- Are costs too high?
  - Is the MS use index greater than 100?
  - Are taxes high?
  - Are utility prices high?

**3** ANALYZE the PROBLEM

| | | | | | |
|---|---|---|---|---|---|
| **4** SOURCES of REFERENCE | * 46, 47, 48 | * 20, 46, 48 | * 55 | * 53 | * 53 | * 53 | * 53, 54 | * 53, 76 |
| **5** DEVELOP ALTERNATE STRATEGIES | Lower price; encourage or pressure for highway development for better access. | | Search cause of boycott; encourage growth of user industry in immediate vicinity. | Raise the maintenance level; raise salaries. | | Force Govt. via:<br>1. Threats, removal/ no expansion of economic activities; new power base.<br>2. Argument: more income = more income revenue. | | |
| **6** DESIRED RESULT | Greater demand due to lowest cost principle. | | Increased demand due to growth and/or removal of boycott. | Increase production by expanding design capacity & employment effect. | | Incur no depreciation due to MS use index; lower property and sales tax payment; lower utility costs. | | |
| **7** REVIEW & EVALUATE | 1. Observe actual results and compare with desired result,<br>2. Measure effectiveness of strategy with respect to both present and future,<br>3. If necessary, recycle. | | | | | | | |

* Numbers refer to list of output sections (Appendix F).

# DECISION–MAKING SEQUENCE: social sector

**1 IDENTIFY the PROBLEM**

Social decision-maker DD learns from his jurisdiction 2 low-income class output that his low-income population units residing on parcel 9824 had sizeable debt during the past year.

**2 RAISE QUESTIONS**

- Was full-time employment adequate?
  - Was time allocated for extra work?
  - Are salaries better than typical?
  - Are there major PL employers nearby?
- Did they take part-time jobs?
  - Is there too much time in recreation?
  - Is time dollar value set low?
  - Is education level competitive?
- Transportation expenditures too high?
  - Are rents/prices/taxes high?
  - Are there bus routes available?
- Were other expenditures inordinate?
  - Are there school / ad. ed. expenditures?
  - Is road network adequate?
  - Is educational level competitive?

**3 ANALYZE the PROBLEM**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **4** SOURCES of REFERENCE | * 20 | * 5a, 85 | * 28 | * 51a | * 51a, 85 | * 62 | * 51a | * 61 | * 51a 33 38 84 | * 51a | * 51a |
| **5** DEVELOP ALTERNATIVE STRATEGIES | Pressure gov't. for growth policy, allocate time to adult education threaten boycott | | | Allocate time to adult education & extra work | | Lower time-dollar value; push for new routes & lower fares; become highway lobby | | | Boycott, back new candidate, decrease costly time allocation | | |
| **6** DESIRED RESULT | Increase full-time wages | | | Supplement income with part-time job | | Use cheaper transportation modes to work; have better access to PG's & PS's | | | Lower and/or eliminate expenses | | |

**7** REVIEW & EVALUATE

1. Compare results as reflected on new output with anticipated results.
2. Evaluate effectiveness of strategies taken;
3. Prepare to recycle and coordinate new strategies;
4. Perhaps implement previously discarded alternatives.

* Numbers refer to list of output sections (Appendix F)

# DECISION–MAKING SEQUENCE

**government sector**

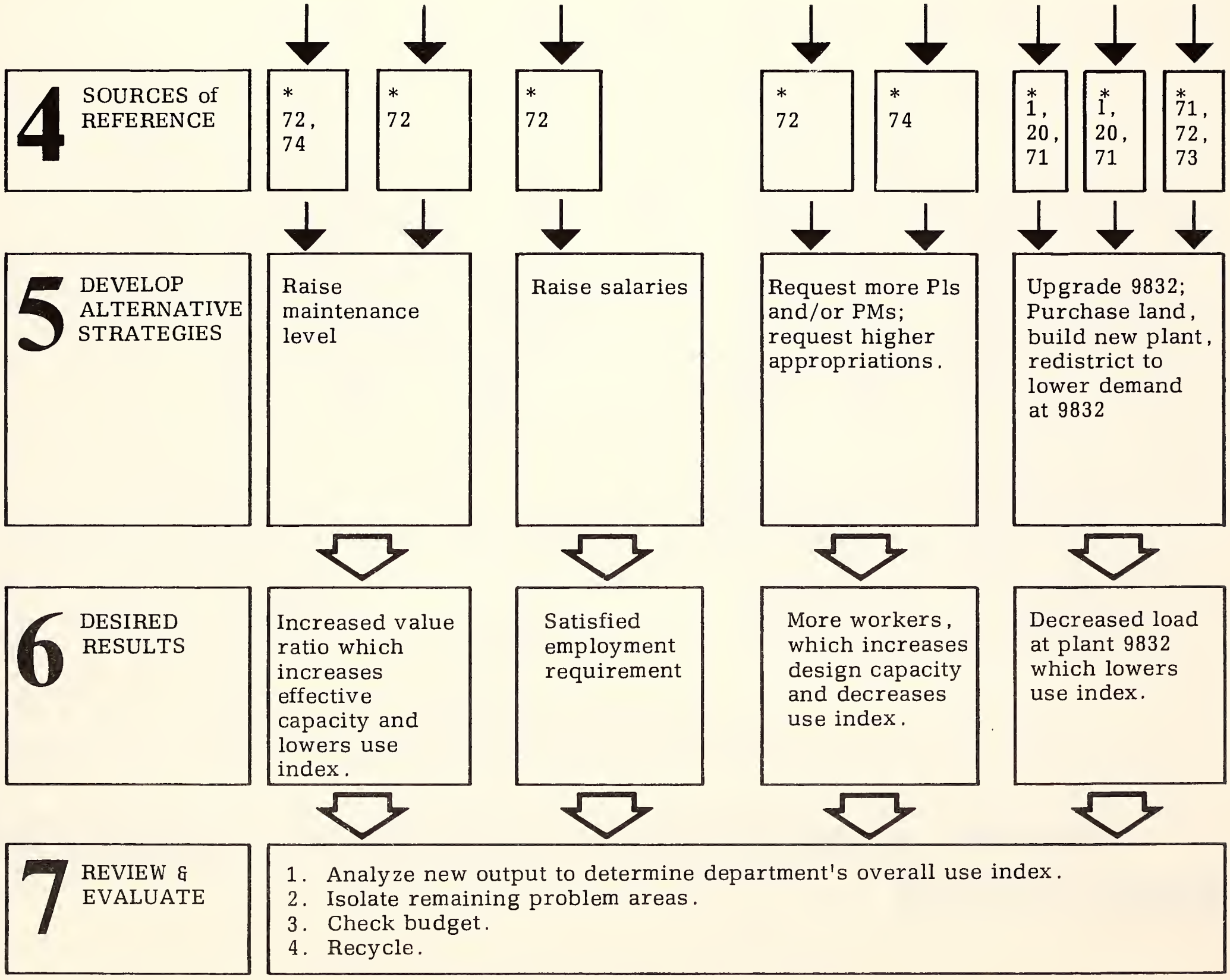
**1** IDENTIFY the PROBLEM

The Municipal Services Department in Jurisdiction 2 sees that one downtown plant at 9430 has a demand exceeding capacity, thereby resulting in a high (oversize) MS Use Index of 155.

**2** RAISE QUESTIONS

- Is the value ratio low?
  - Is re-districting feasible?
  - Can you afford the renovation?
- Did department run efficiently?
  - Can the maintenance level be raised? (Is it at 100% already?)
- Can employment mix produce a sufficient design capacity?
  - Is redistricting feasible?
  - Does total demand warrent new plant?
  - Is the demand concentrated?
  - Can the department afford a higher wage expenditure?
  - Is employment request at the maximum?
- What is the per parcel drain (usage) on the department?

**3** ANALYZE the PROBLEM




* Numbers refer to list of output sections (Appendix F).

3. Director Input Decisions

The Director has unique decision options available during the players' round. The purpose of the options is to provide the operator with as much flexibility as possible in the game situation. Those options are described below with examples and summarized at the end of this section. The instructor may employ any combination of options.

ONE. Transfer of cast TO and FROM the outside system.

In order to correct financial imbalance or to simulate federal grants, etc., the Director can transfer cash to an economic decision-maker or to the capital or current account of the Chairman or a department. He uses the regular $CASH routine but his decision-maker is ØU (for Outside System).

The following is the correct format:

$CASH/=ØU/C, x, y, PVT, z

where x is the receiver (economic decision-maker or department and jurisdiction)

y is the amount in dollars (no commas or dollar signs)

z refers to the type account into which the amount is going; i.e., PVT if to an economic team; CUR, a department's current account; CAP, a department's capital account.

For example, if the Director wants to transfer one million dollars to the Jurisdiction 1 School Department's capital account, he would type:

$CASH/=OU/C, SC1, 1000000, PVT, CAP

The Director can also use a similar format when transferring money from a decision-maker's account to the outside system:

$CASH/=SC1/C, OU, 1000000, CAP, PVT

Such action may be taken to induce serious governmental debts or an economic recession for example.

TWO. Float capital bonds.

Since capital bonds are subject to referenda, they should be floated by the Director upon approaval by the social sector. The input format for capital bonds is: $OTHER/=department and jurisdiction receiving/BO, amount (in $10,00's), 25. For example, if a capital bond of 25 million dollars is approved for the Jurisdiction 2 Municipal Services Department, the format would be:

$OTHER/=MS2/BO, 2500, 25.

All capital bonds have a term of 25 years and the interest rate is determined by the computer.

THREE. Price and salary changes.

The computer program does not allow salaries or prices to be set at less than half of typical or more than one and one-half times typical. This limitation can be by-passed by typing certain characters (see Appendix E) after the last legal column of an input decision. For example, if the School Department in Jurisdiction 1 wanted to set salaries for middle income to $9,000 and high income to $15,000, the Director could type $OTHER/=SCL/A,90, 150, 0, A and the decision could be accepted by the input program (EDIT).

FOUR. Land bids.

If the Director wishes, he can control the bids on all parcels of land owned by the computer. He can determine which parcels of land are up for auction and which bidder will get each parcel of land through game administration. In order to guarantee that a player receives a parcel of land, the Director uses the following input format:

$PU/=team bidding/location, price (in $1000's)

OU, percent of parcel (0, if all), 1.

For example, if economic decision-maker B has bid $150,000 on parcel 7224 and the Director wants to guarantee that B receives it, he would type:

$PU/=B/7224, 150, OU, O, 1

The "1" in the last column tells the computer not to handle the bid in the ordinary manner (as explained in the Players' Manual) but to guarantee it to the decision-maker who is initiating the bid and has input valid data in the first three or four columns.

FIVE. Create or remove public land (Preempt Land Use).

The Director may use the Preempt category to represent any type or mixture of non-usable land that he wants. For example, he can suggest that preempt land represents institutional land holdings (such as federal land, military bases, large land easements, cemeteries, golf courses, country clubs, and non-usable public land) or land that is not usable because of topographical constraints (water bodies, excessive slopes, swamp or marshland or rock outcroppings). The Director can add an amount of preempted land to the local government (representing perhaps a federal land grant) or to the economic sector at a price (representing perhaps the cost of an expensive land fill operation on a piece of swamp property to make it usable for development).

Since the Preempt Land Map will not distinguish the type of preempt category for any particular parcel, it is the responsibility of the Game Director to record which land is in the various types of uses (i.e., water, airport, federal reservation, etc.). The game operator's ability to start play with any amount of preempt land allows him great influence in the play of the model if he wants to exercise it.

The input format is:

$CVPT/=ØU/PLND, location, percent of parcel to be added to undevelopable.

$CVPT/=ØU/RPLND, location, percent of parcel to be taken out of undevelopable.

For example, the Director may decide that he will represent the land taken away from potential local development by creating an airport near the edge of the city, at 8230. He will put 60% of the parcel into preempt use and give the owner, B, $1.5 million for the land.

$CVPT/=ØU/PLND, 8230, 60

$CASH/=ØU/C, B, 1500000, PVT, PVT

If, on the other hand, the Director desires to make some preempt land available for purchase and/or development he may make a RPLND (remove preempt land) decision. In this case, the land goes into the holdings of whichever private land owner (an economic team or the outside system) possesses other privately-owned land on that particular parcel. If all land on the parcel was previously preempt and publicly owned or just preempt, the outside system would become the new owner. The following three cases will illustrate the usage of RPLND.

Case One. Parcel 10020 was a military reservation, entirely in the preempt category. The input:

$CVPT/=ØU/RPLND, 10220, 40

makes forty percent of the parcel available for purchase by any government or economic decision-maker by means of a land bid to the outside system.

Case Two. Forty percent of the same parcel is to be bought outright by economic decision-mkaer B and twenty percent by UT2. Assume that the Director has placed the cost at $1,000,000 for 100 percent of the parcel (although not all will be available). The transactions would be completed via the following inputs (there are alternative methods which would also work):

$CVPT/=ØU/RPLND, 10020, 60
$PU/=B/10020, 600,ØU, 0, 1
$PU/-UT2/10020, 200 B, 20

Case Three. Economic team C owns twenty percent of parcel 7630. The remainder (eighty percent) has been preempt but the Director decides to allow team C to purchase the remainder for $650,000. The required inputs:

$CVPT/-ØU/RPLND, 7630, 80
$CASH/-C/C, 650000, ØU, PVT, PVT

SIX. Decide to use a construction industry.

If the Director decides to incorporate a Construction Industry in the game, players may contract for construction with a local CI, or have an outside firm perform the work at 130% of the typical cost. If local CI's are allowed in the game, a new development begins operation in the round after the decision to build is accepted by the computer. The Director may want to simplify construction procedures by having all construction performed by outside firms at 100% of typical cost. In this case, as there are no player-operated CI's on the board, a new development begins operation immediately after the construction decision is submitted and accepted by the computer.

By operating local construction industries the system retains much more revenue in terms of CI income and its subsequent distribution to profits, salaries, goods and services establishments, and taxes, and moreover, boosts employment. On the other hand, players may desire to avoid contending with the relative complexity of this particular economic activity. Furthermore, the local CI situation (YESCI) requires that construction projects take one more round to complete than the NOCI situation, in which completed projects appear the round immediately following the contract input.

The Director may want to begin the game without a CI and allow it to be used after the players acquire some familiarity with the model. Or, if the game is to be run with a group for only a few rounds, the Director may want to enable players to see the results of their construction decisions sooner than they would if CI were used. In this case, players should use the $OUBLD input for all construction and demolition.

The computer programs operate as though CI's are being used unless the Director specified otherwise. Either decision, once made, is in effect until the Director changes it.

The input code to prohibit CI is:

$OTHER/=ØU/NØCI

This decision will not take effect if there is a CI on the board. The Director must demolish all CI's with the regular demolition input format, and then decision to prohibit CI.

If the Director wishes to use a data base which already has CI's and/or has not been specified NØCI, he can perform the necessary demolitions and/or NØCI specifications before running Round 1 output.

After NØCI has been accepted by the computer, the computer will accept no attempts to build CI's. All construction costs will be equal to the typical costs. New development will begin operation in the same round that the construction decision is input.

The input to allow local construction industries is:

$OTHER/=OU/YESCI

For example, the Director may choose to show how a natural disaster affects the city. Subsequently, he announces through the media, the destruction caused by the disaster and puts in the actual demolition decisions as though he were the owner of the developments and/or transportation links. Suppose the disaster demolished a section of highway and a level one Light Industry bordering the highway. Assume that the Light Industry owned by economic decision-maker B, is located at 9840, and the highway is an HY2 at 9839 and is in jurisdiction one. Then the required input decisions are:

$OUBLD/=B/9840, LI, 1, 0

$OUBLD/-HY1/9839, HY2, 0

To compensate for the expenditures incurred by these demolitions the Director can transfer cash into team B's and the Highway Department's account. (See decision option #1, page 34.)

For emphasis, the Director may make any player decision, but he should use caution in exercising this option. If the reasons behind his decisions seem unclear and/or illegitimate to the players, they may revolt and institute illegitimate decisions of their own. In order to prevent such player reactions, the Director may have to set up a "judiciary" which reviews all decisions to assure that the legal teams made them. Of course, the Director could assume responsibility for the review.

SEVEN. Vary the number of in-migrants.

The instructor may specify the number of in-migrants, including those due to natural population growth. This decisions applies for one round only. For any population class where the instructor has not specified the number of in-migrants, the program will use the in-migration portion to determine the number of in-migrants.

The input format is:

$OTHER/=ØU/class (INHI, INMID, or INLO), number of Pl's to be inmigrants.

For example, during the fourth round the Director wishes to force a severe low-income unemployment problem and a shortage of high-income workers. He decides that he will move in 60 PL's and no PH's. He submits the following cards.

$OTHER/=ØU/INLO, 60

$OTHER/=OU/INHI, 0

The migration routine determines the in-migration for all classes not specified (in this case, middle). The next round, the instructor does not wish to set the number of in-migrants for any class in any jurisdiction, so he submits no in-migration inputs.

4. Putting in Decisions and Punching Cards

Once the Director and players have coded their decisions on the input forms, the decisions must be keypunched onto cards, one decision per card. The Director should be aware of several mechanical procedures and card-punching shortcuts.

The two most crucial items of information necessary for each decision are the dollar sign code, (for example, $CASH, $CVPT) which determines the type of decision, and the decision-maker (a government, economic or social sector team or the Director). Note that each of these items is preceded by a special character ("$" or "=") and is followed by a slash ("/"). The information before a slash need by repeated only when it changes; i.e., when the decision type ($ code) and/or decision-maker are different from the last accepted code and/or team. Technically, a valid $ code followed by a slash always replaces the previous $ code; a valid = decision-maker followed by a slash always replaces the previous decision-maker. Thus, once an input decision has been accepted by the EDIT program, the subsequent inputs may require none of the primary information or only one of the two items.

For example, if economic decision-maker A were purchasing parcel 9418 for $120,000 from economic decision-maker C and parcel 9812 for $150,000 from economic decision-maker D, the inputs could be keypunched on the cards as follows:

Card 1: $PU/=A/9418, 120, C

Card 2: 9812, 150, D

The next example illustrates inputting several economic decisions. B is changing a maintenance level, C is changing a rent, A is changing maintenance levels and a rent and purchasing two parcels as described on page 43.

Card 1: $CVPT/=B/M, 10428, 95

Card 2: =C/R, 8222, 145

Card 3: =A/M, 10832, 97

Card 4: M, 9634, 92

Card 5: R, 7632, 160

Card 6: $PU/9418, 120, C

Card 7: 9813, 160, D

Each decision should be entered on a separate card to simply present the decisions as well as determine to which error statements the EDIT program refers. Of course, each distinct decision with its complete code may be put on a separate card.

As noted in the Players' Manual, there are some shortcuts especially applicable to zoning and district boundary changes, where the listing of parcels is valid.

Any information within parentheses is treated in the same way; e.g., if a player is changing the maintenance level of several developments to 90, he could type (9228, 9830, 7212, 8814) where location is requested. This saves typing an entirely separate input for each location.

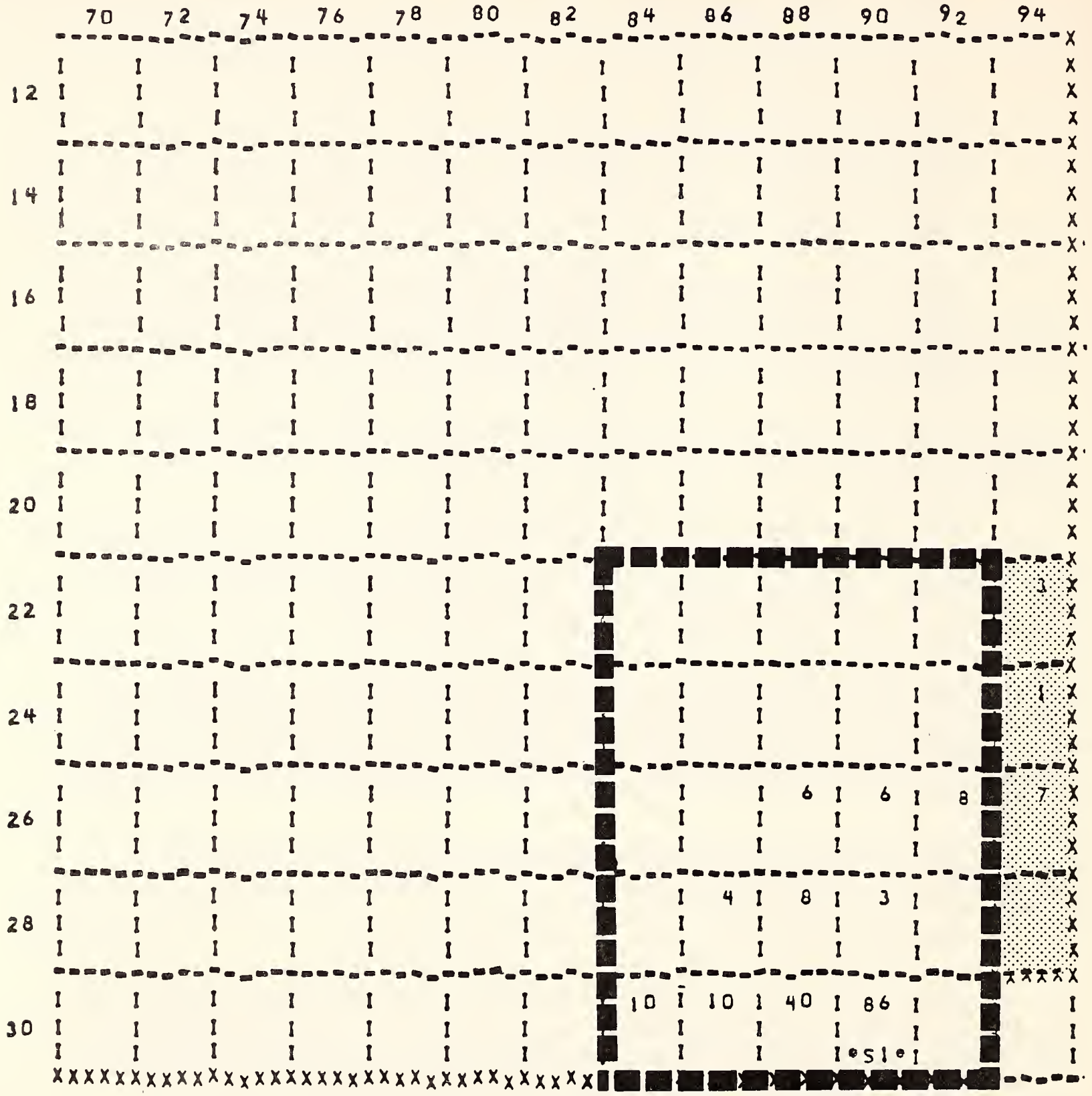
If all of the parcels in a rectangular area are to be treated the same way, the parcels at opposite corners of the rectangle can be designated with a " > " between them where location is requested. For example, the School Department may want to make the outlined area in the figure on the following page a school district for the school at 9030. The location could be specified as (8422 > 9230).

If the line of parcels from 9422 through 9428 were also to be part of the district, the entire input would be:

$REDIST/=SCl/9030, (8422> 9230, 9422 > 9428)

Once the Director and player input decisions have been punched onto cards, the Director must sequentially order the cards. Properly sequencing the cards is important because the data files (team cash balance, ownership, zone, etc.) are updated in the order that the inputs are processed. For example, a decision-maker could buy land, change that parcel's zoning, have utility service installed on that parcel, borrow the funds for construction, and then build on the parcel all during the same round of decision-making. He could do all that only if the inputs required to accomplish all the tasks were ordered in such a way that the build decision was last, as is the case in the enclosed suggested sequence. While the Director may deviate from any prescribed order, the following sequence for inputs is recommended for maximum decision-making success.

SCHOOL MAP


70
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22
24
26
28
30
1
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6
8
7
4
8
3
10
10
40
86
5
1

1. $CASH ... all cash transfers, appropriations and subsidies

*2. $OTHER/=dm/BO or LO ... borrow or loan

3. $PU ... all land purchases and bids

4. $TAXES ... tax rates

5. $ASMNT ... assessment decisions

6. $FSA ... all requests for federal/state aid

7. $CVPT/=PZ/Z ... zoning changes

8. $OUBLD/=UT/ ... build utility plant

9. $VVPT/=UT/US ... change utility service

10. $OTHER/=UT/P ... change utility prices

11. $BUILD ... all construction projects

12. $OUBLD ... all outside construction projects except for utility plants

13. $CVPT/=MS or SC/E ... change employment for municipal services or schools

14. $CVPT/=MS or SC/M ... change maintenance level for municipal services or schools

15. $REDIST/=MS or SC ... change district boundaries

16. $OTHER/=MS or SC/S ... change salaries

17. $RAIL ... build rail lines or stations

18. $ROUT/=BUS or RAIL ... change routes or level of service

19. $OTHER/=BUS or RAIL/PS, SS, P, S, or M ... purchase rolling stock, sell rolling stock, set fares, change salaries or change maintenance level

20. $OTHER/=HY/M ... change highway maintenance

---

*dm refers to either government or economic decision-makers.

**21. $CVPT/=edm/R, P, S or M ... change rents, prices, salaries or maintenance level

**22. $OTHER/=edm/SP, CN, SELL SP, SELL CN ... buy or sell speculative or conservative stocks

23. $TIME ... allocate time by class and/or parcel

24. $BYCT ... boycott working, shopping or using public transit

25. $VALUE ... change the dollar value of time

Finally, listed below are assorted notes on player input procedures.

a. Requests for federal/state aid for road construction must contain the location in parentheses. The location of the intersections at either end of a straight-line section must be given. If the road turns, the intersections at both ends of each straight-line section must be listed.

b. Requests for capital federal/state aid should be processed one round before a department attempts to build something or in the case of PZ, purchase land with the money.

c. Since installations of utility service must be "connectable," they must be fed to the computer in order.

Ordering the input cards is the final step before submission of the inputs to the computer. The program EDIT accepts correct decisions and makes the player and Director specified changes to the data base. EDIT also rejects incorrect decisions and prints diagnostic messages below each rejected decision to indicate the source of the error. This output from the EDIT program is discussed thoroughly in Appendix D. Appendix C reiterates the mechanics involved in preparing player inputs. Both appendices are necessary supplements to this section of the manual.

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** edm refers to economic decision-makers.

# APPENDIX A

## PLAYER THUMBNAIL DECISION CHECKLISTS BY SECTOR

ECONOMIC

SOCIAL

GOVERNMENT

ECONOMIC SECTOR THUMBNAIL
DECISION CHECKLIST

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| BUILD OR UPGRADE RESIDENCES | Location<br>Type (C; B; or A)<br>Level (1 to 8)<br>QI (40, 50, 60, 70, 80, 90, 100)<br>ML (0 to 100)<br>Rent/Space Unit | Land availability (12% required/level)<br>Construction costs<br>Cash balance<br>Zoning<br>Level of Utility Service<br>Road access |
| BUILD OR UPGRADE BASIC INDUSTRY | Location<br>Type (HI; LI; NS)<br>Level (1 to 3)<br>ML (0 to 100)<br>Salaries | Land availability<br>Construction costs<br>Cash balance<br>Zoning (t, u, r, a4, a5)*<br>Level of Utility Service<br>Road access<br>Proximity to residential units |
| BUILD OR UPGRADE COMMERCIAL | Location<br>Type (BG; BS; PG; PS)<br>Level (1 to 3)<br>ML (0 to 100)<br>Price/Cu<br>Salaries | Land availability<br>Construction costs<br>Cash balance<br>Zoning (30, 32, 33, 34, 35)*<br>Level of Utility Service<br>Road access<br>Terminal access (for BG only)<br>Market potential<br>Proximity to residential units |

*letters refer to List of Output Sections -- Appendix F, page 105

ECONOMIC SECTOR THUMBNAIL DECISION CHECKLIST -- continued

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| BUILD OR UPGRADE CONSTRUCTION INDUSTRY | Location<br>Level (1 to 3)<br>ML (0 to 100)<br>Salaries | "YESCI" Option that cash balance exceeds $120,000,000<br>Land availability (20%/level)<br>Zoning (t to w)*<br>Proximity to residential units |
| MAINTAIN RESIDENTIAL UNIT | Location<br>Maintenance Level (0 - 100)<br>20 points greater than above the lowest QI ever reached | Renovation Costs or Savings<br>What class wanted as residents |
| MAINTAIN COMMERCIAL, CONSTRUCTION INDUSTRY AND BASIC INDUSTRY | Location<br>Maintenance Level (0 - 100) | Renovation costs or savings<br>Desired capacity |
| PURCHASE LAND PROPERTY | Location<br>Seller<br>Amount ($) | If bid, market value<br>Cash balance<br>Potential of property |
| BORROW | Source<br>Term<br>Amount | Interest rate<br>Credit rating<br>Rate of return |
| CHANGE RENTS | Location<br>Amount | Trade off: e.g., high rents will only increase income if residents stay.<br>System-wide vacancy rate<br>Unemployment rate<br>MS Use Index<br>School Use Index |

*letters refer to List of Output Sections -- Appendix F, page 105

ECONOMIC SECTOR THUMBNAIL DECISION CHECKLIST -- continued

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| CHANGE PRICES | Location<br>Amount | Competition<br>Percent over/under capacity<br>Income trade-off |
| CHANGE WAGES | Location<br>Amount | Unemployment rate<br>New Employers<br>Profitability<br>Proximity to residential units |
| INVEST | Type (speculative or conservative)<br>Amount | Business Cycle<br>Cash Balance<br>Opportunity Cost |

SOCIAL SECTOR THUMBNAIL
DECISION CHECKLIST

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| TIME ALLOCATION | Class<br>Jurisdiction<br>Parcel | Trade offs between each of the following: |
| For Extra Work | Amount | Savings, relative education level, supply of jobs |
| For Public Adult Education | Amount<br>(only for PM and/or PL) | Employment status,<br>Education level, Supply of teachers |
| For Private Adult Education | Amount | Savings, Future income gain,<br>Cost |
| For Politics | Amount | Registered voters,<br>Potential political influence |
| For Recreation | Amount | Cost, Dissatisfaction level |
| VOTE | Candidate<br>Referendum | Issues, Platform<br>Record |
| BOYCOTT | Location, Class<br>Type (shop, work, use)<br>Stop/Begin | Potential effect, additional support,<br>Alternatives |
| SET TIME DOLLAR VALUE | Amount (0 to 100)<br>Class | Modal preference<br>Savings |

GOVERNMENT SECTOR THUMBNAIL
DECISION CHECKLISTS

CHAIRMAN by Jurisdiction

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| SET LOCAL TAXES | Among alternatives below | Revenue needs, Trade offs, Assessments, Forecasted bases, Rates of neighboring jurisdiction(s) |
| LAND, IMPROVEMENT | Rate (0.0 to 9.9)<br>Type (Land or Development) | Impact on Economic Sector<br>Desired share of total revenue |
| PERSONAL INCOME AND AUTOMOBILE | Rate (0.0 to 9.9)<br>Type (RI, EI, RA, EA) | Effect on migration, Effect on voters<br>Effect on commuters |
| SALES | Rate (0.0 to 9.9)<br>Type (G or S) | Profitability and type of establishments<br>Effect on migration<br>Desired share of total revenue |
| GRANT APPROPRIATIONS | Department (MS, HY, SC, PZ)<br>Account | Needs<br>Resources - alternatives<br>Revenues |
| GRANT SUBSIDIES | Department (UT, BUS, RAIL) or Economic Team<br>Amount<br>Account | Needs<br>Resources - alternatives<br>Revenues<br>Future benefits |
| SET WELFARE RATE | Amount | Unemployment rate, Revenues,<br>Effect on migration, Effect on voters<br>Needs of Population |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| DEMOLISH SCHOOL | Level<br>Employment Request<br>Location | Trade off between renovation, Demand, Resources, Impact on voters |
| PROVIDE ADULT EDUCATION | Amount | Cash balance (current)<br>Effect on system:<br>Distribution of income<br>Effect on education levels<br>Impact on voters |
| CONTRACT | Type, Location,<br>Owner, Percent | Price<br>Owner good will |

MUNICIPAL SERVICES BY Jurisdiction

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PURCHASE | Location, Seller<br>Amount of land<br>Amount of $ | Market value<br>Cash balance (capital)<br>Property potential |
| CHANGE EMPLOYMENT MAINTENANCE LEVEL | Location<br>Amount (PL-PM; 0 to 100) | Effect on capacity<br>Budget restrictions<br>Effect on PL unemployment |
| REDISTRICT | Location of plant<br>Location of district | Demand (load) by parcel<br>Capacity of plant<br>Continuity of districts |
| CHANGE WAGES | Amount | Unemployment rate, New employers,<br>Migration effect, Budget restrictions |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

ASSESSMENT by Jurisdiction

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| ASSESSMENT | Type (juris-wide, SZ, SA)<br>Locations<br>Rate (0.0 to 100.0) | Property rates, Desired tax base,<br>Economic status, political impact |

SCHOOL by Jurisdiction

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PURCHASE LAND | Location, Seller<br>Amount of Land<br>Amount of Dollars | Market value<br>Cash balance (capital)<br>Property potential |
| CHANGE EMPLOYMENT MAINTENANCE LEVEL | Location<br>Amount (PM-PH or 0 to 100) | Effect on school capacity<br>Effect on PM, PH students<br>Budget restrictions |
| REDISTRICT | Location of school<br>Location of district | Number and class of students<br>School capacity and measures<br>Continuity of all districts |
| CHANGE WAGES | Amount | Unemployment Rate<br>New Employers, Migration effect<br>Budget restrictions |
| CONSTRUCT NEW SCHOOL | Level, Location<br>Maintenance Level<br>Employment request | Demand, Impact on voters<br>Land availability<br>Resources (including availability of FSA) |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

| DECISIONS | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| CONSTRUCT NEW PLANT | Level, Location<br>Maintenance level<br>Employment request | Land availability, Resources<br>Potential demand<br>Impact on Voters |
| CONTRACT | Type, Location, Owner<br>Percent, Priority | Price<br>Owner good will |

HIGHWAY by Jurisdiction

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PURCHASE | Location, Seller<br>Amount of land<br>Amount of Dollars | Cost (market value)<br>Cash balance (capital)<br>Property usefulness |
| CHANGE MAINTENANCE LEVEL | Type (1, 2, or 3)<br>Level (0 to 100) | Cost (possible trade off to upgrade)<br>Usage |
| BUILD OR UPGRADE HIGHWAYS | Level<br>Location | Cash balance (capital)<br>Actual and potential usage<br>Costs of rights-of-way<br>Construction costs<br>Revenue sources, Effect on voters<br>Jurisdiction boundary |
| BUILD OR UPGRADE TERMINALS | Level<br>Location | Cash balance (capital)<br>Potential sites, Current usage<br>Potential demand<br>Jurisdiction boundary |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

| DECISIONS | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| APPLY FOR FSA | Level<br>Location | Time Lag<br>Probability of grant |

**PLANNING AND ZONING by Jurisdiction**

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PURCHASE LAND | Location, Seller<br>Amount of land<br>Amount of dollars | Population location and density<br>Desired greenbelt areas<br>Master Plan, Cash balance (capital) |
| ZONE | Location(s)<br>Zone | Master plan, Desired land use<br>Political impact |
| CHANGE PUBLIC INSTITUTIONAL LAND | Location<br>Amount | Location and amount of PZ undeveloped land<br>Cash balance (capital), Intended use |

**UTILITY by Jurisdiction**

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PURCHASE LAND | Location, Seller<br>Amount of land<br>Amount of dollars | Market value, Cash balance (capital)<br>Property potential<br>Locations of area of service (actual and potential) |
| PROVIDE SERVICE | Location of plant<br>Location of parcel(s) requiring new service | Cash balance (capital)<br>Location of plant districts<br>Effect of new usage on plant operating costs<br>Capacity of installation and service |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

| DECISIONS | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| PRICE | Amount | Cash balance (current)<br>Operating costs (projected), political impact |
| CONSTRUCT NEW PLANT | Location<br>New level | Land availability<br>Cash balance (capital)<br>Area of service (potential and actual) |

BUS

| DECISION | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| CAPITAL STOCK ADJUSTMENTS | Purchase (PS) or Sell (SS) Amount | Miles of service<br>Needed capacity for all lines<br>Cash balance (capital) |
| CHANGE SALARY | Amount to PM workers | Unemployment rate<br>Competitiveness of labor market<br>Average wage to PM's |
| CHANGE MAINTENANCE LEVEL | Amount | Cash balance (current)<br>Needed capacity for all service<br>Units owned |
| CHANGE PRICE | Base fare<br>Per mile fare | Social time dollar value<br>Congestion<br>Cash balance (current) |
| CHANGE ROUTE(S) | Route number<br>Desired level of service<br>Exact route (home to work) | Highway locations<br>Traffic patterns, Capacity of route(s)<br>Total serviceable units |

GOVERNMENT SECTOR THUMBNAIL DECISION CHECKLISTS -- continued

| DECISIONS | PLAYER CHOICES | CHECKPOINTS |
|---|---|---|
| CAPITAL STOCK ADJUSTMENTS | Purchase (PS) or<br>Sell (SS) Amount | Miles of service<br>Demand for stock<br>Needed capacity for all lines<br>Cash balance (capital) |
| CHANGE PRICE | Base fare<br>Per mile fare | Social time dollar value<br>Capacity/congestion<br>Cash balance (current) |
| CHANGE SALARY | Amount to PM worker | Unemployment rate, Average wage to PM's<br>Competitiveness of labor market |
| CHANGE MAINTENANCE LEVEL | Amount | Cash balance (current), Units owned<br>Needed capacity for all lines |
| PURCHASE LAND | Location, Seller<br>Amount of dollars | Market value, Cash balance (capital) |
| CONSTRUCT TRACKS AND STATIONS | Location(s)<br>Parcels over which track is built | Cash balance (capital), Proposed routing<br>Inducement to usage build up<br>Stations coincident with tracks and road bed intersections |
| CHANGE ROUTE(S) | Route number<br>Desired level<br>Exact route (home to work) | Track and station locations<br>Population density<br>Traffic patterns, Capacity |

# APPENDIX B

## FLOW DIAGRAMS:

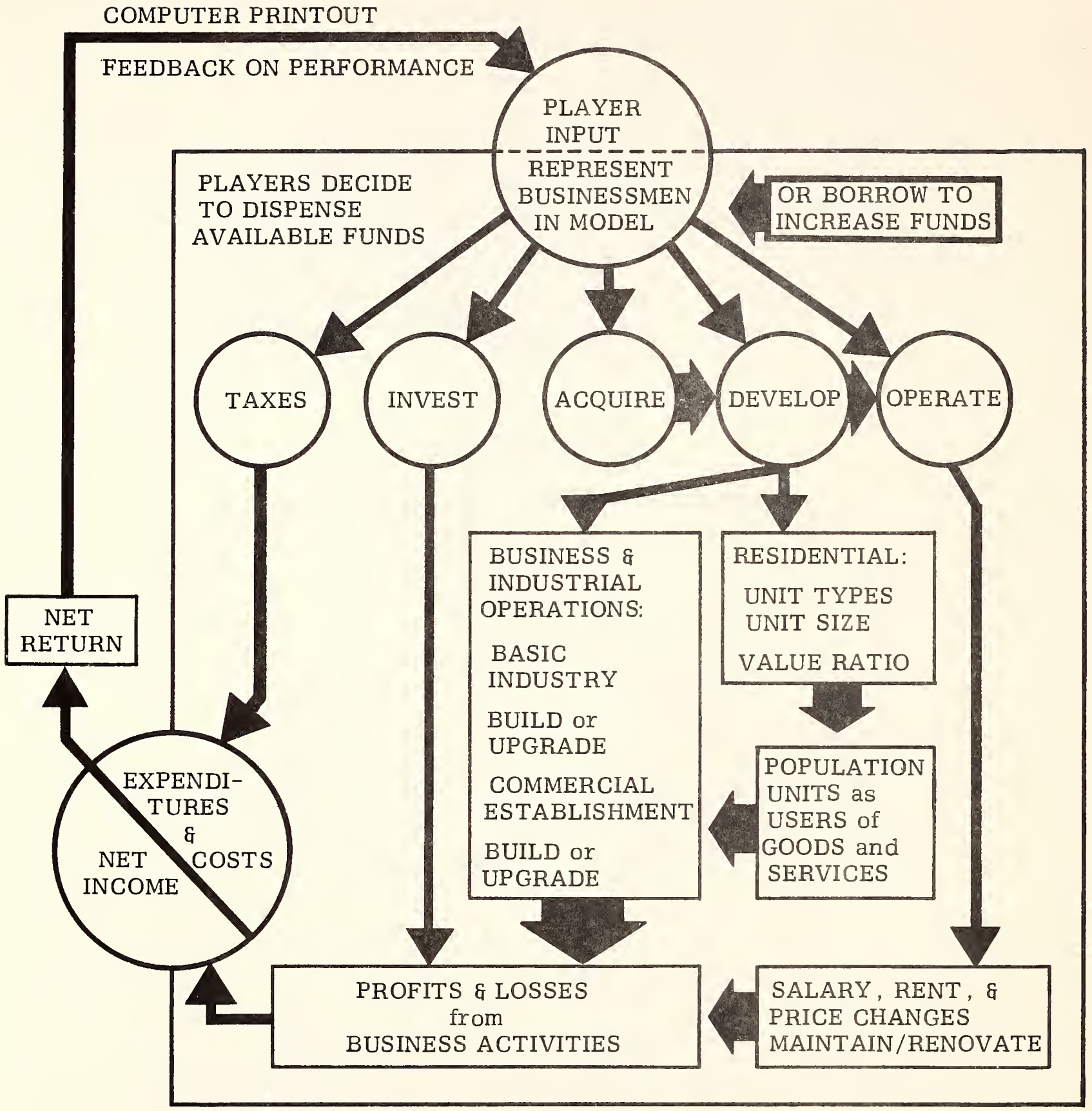
## INTERRELATIONSHIPS IN THE CITY MODEL

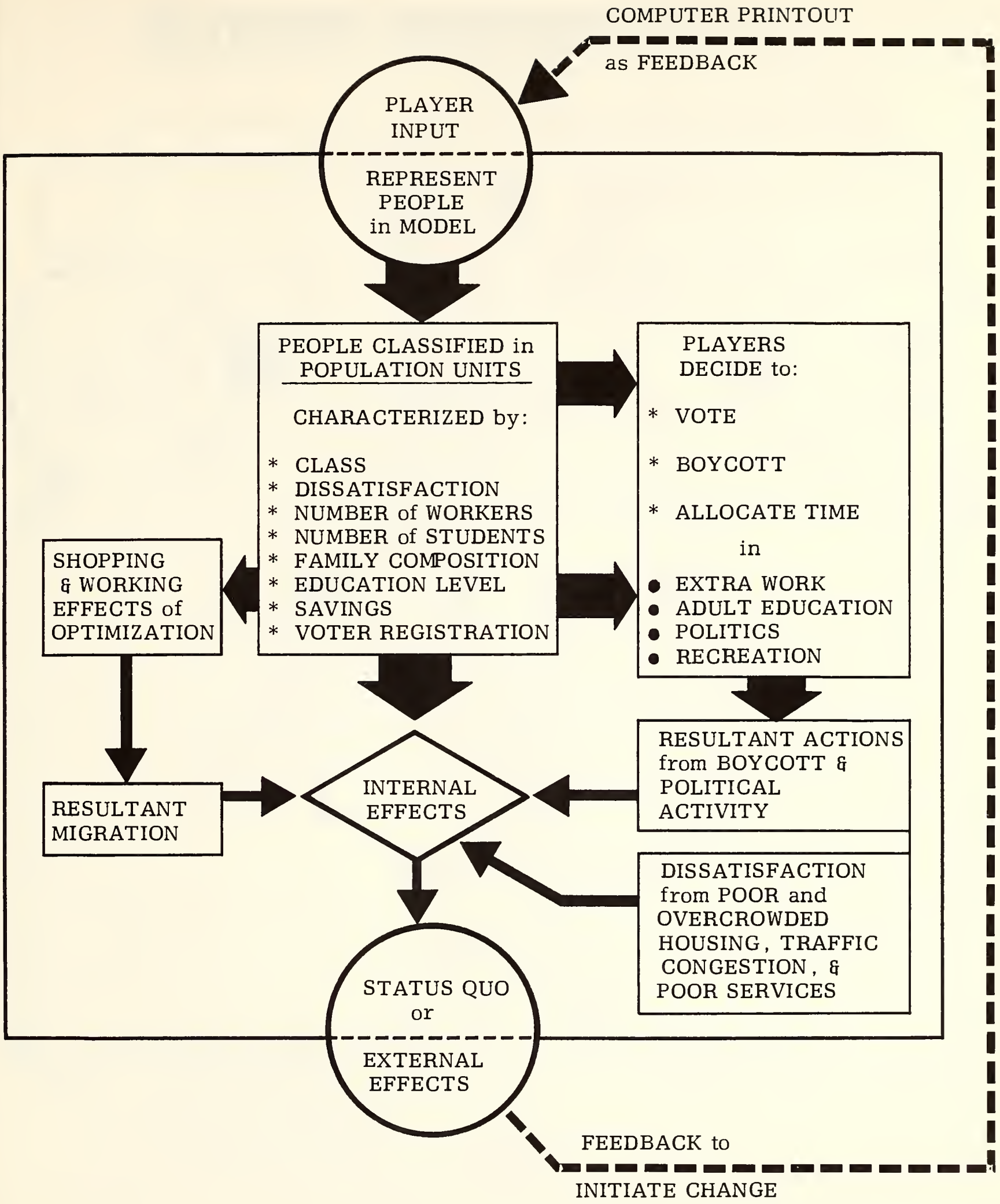
ECONOMIC SECTOR

SOCIAL SECTOR

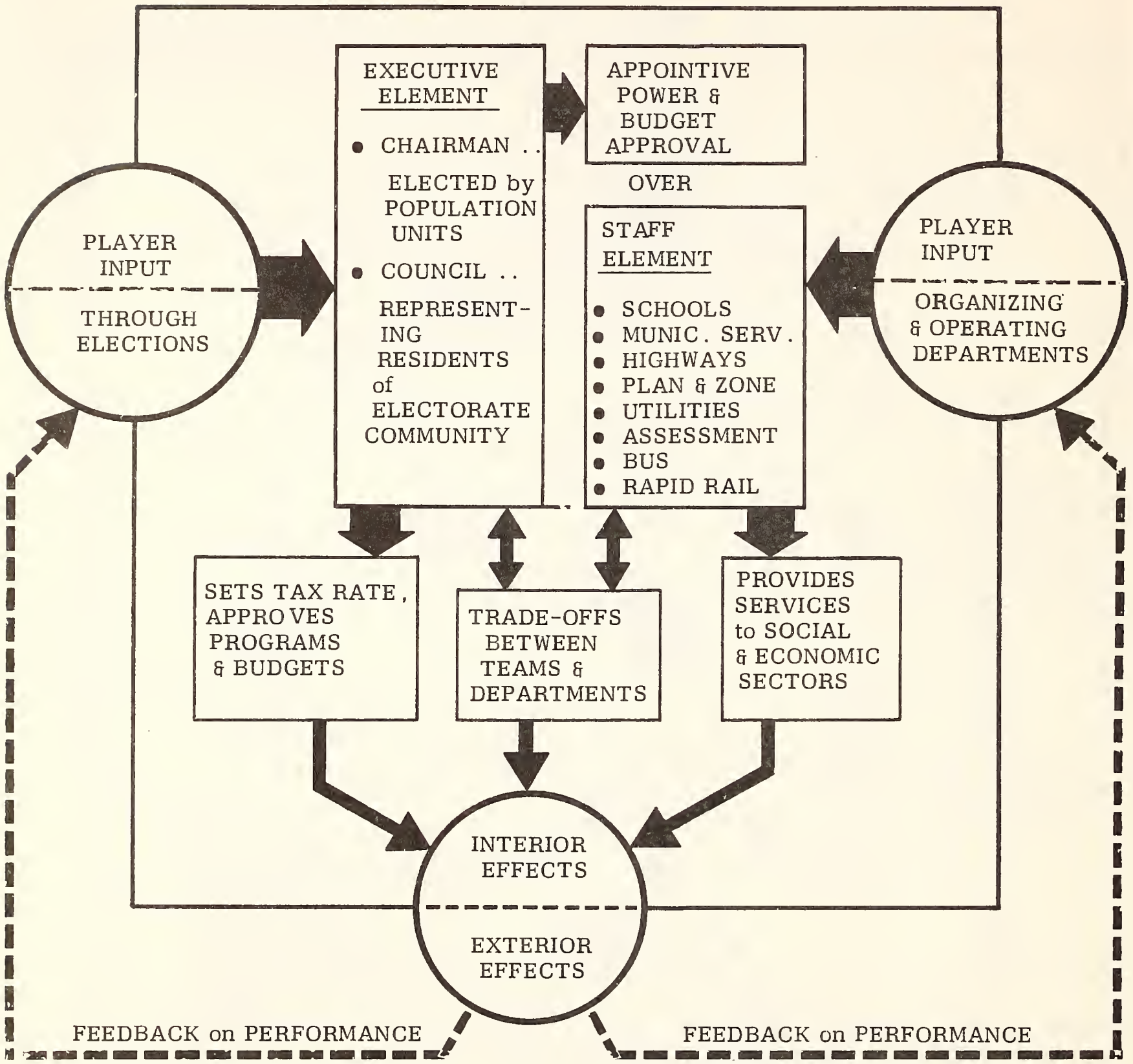
GOVERNMENT SECTOR

# ECONOMIC SECTOR

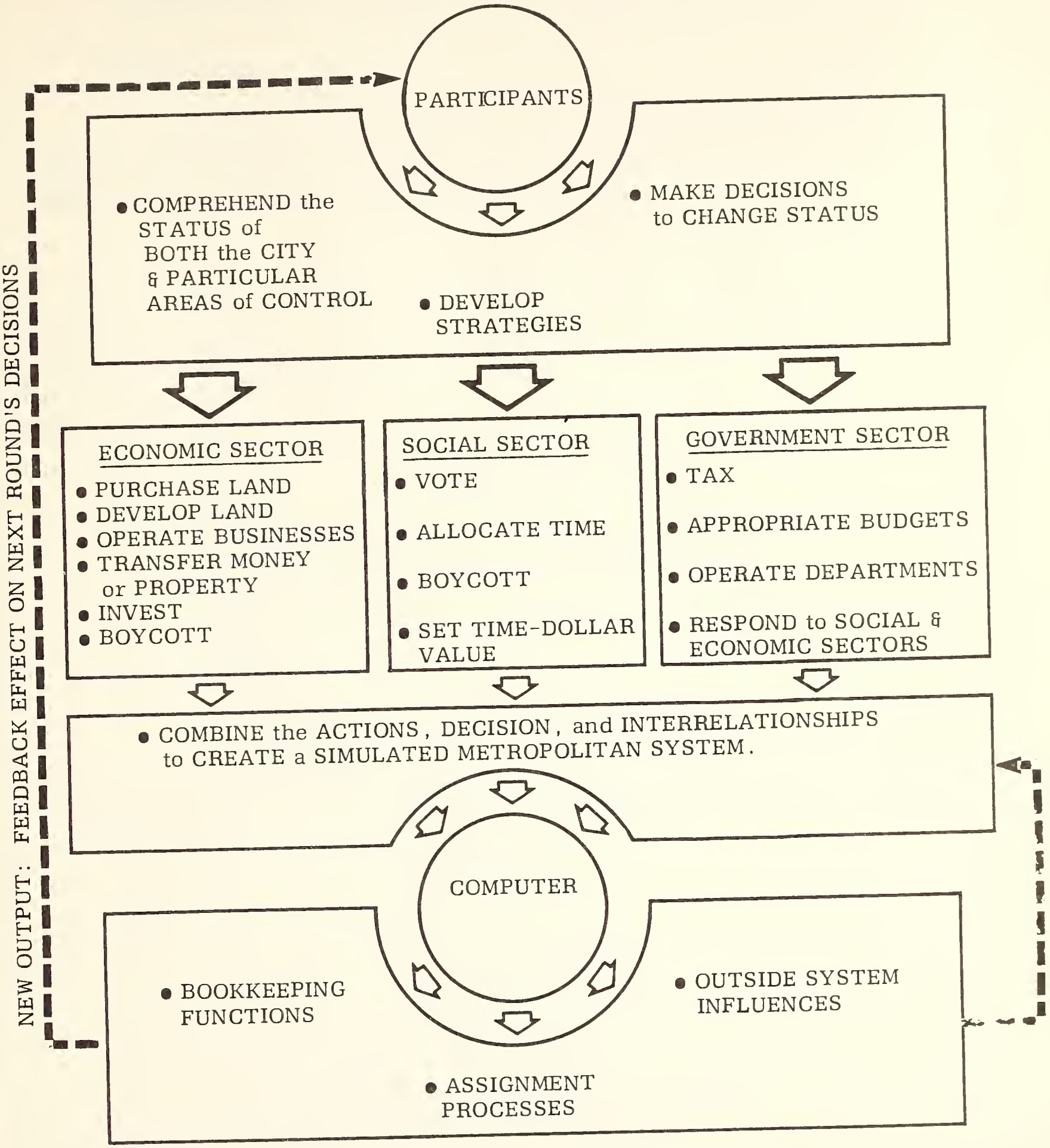



COMPUTER PRINTOUT
as FEEDBACK
PLAYER INPUT
REPRESENT PEOPLE in MODEL
PEOPLE CLASSIFIED in POPULATION UNITS
CHARACTERIZED by:
* CLASS
* DISSATISFACTION
* NUMBER of WORKERS
* NUMBER of STUDENTS
* FAMILY COMPOSITION
* EDUCATION LEVEL
* SAVINGS
* VOTER REGISTRATION
PLAYERS DECIDE to:
* VOTE
* BOYCOTT
* ALLOCATE TIME in
• EXTRA WORK
• ADULT EDUCATION
• POLITICS
• RECREATION
SHOPPING & WORKING EFFECTS of OPTIMIZATION
RESULTANT MIGRATION
INTERNAL EFFECTS
RESULTANT ACTIONS from BOYCOTT & POLITICAL ACTIVITY
DISSATISFACTION from POOR and OVERCROWDED HOUSING, TRAFFIC CONGESTION, & POOR SERVICES
STATUS QUO or EXTERNAL EFFECTS
FEEDBACK to INITIATE CHANGE

# GOVERNMENT SECTOR



INTERRELATIONSHIPS in the CITY MODEL



# APPENDIX C

## INPUTTING DECISIONS IN THE CITY MODEL

APPENDIX C: Inputting Decisions in the City Model

In order to input a decision in the CITY MODEL, players or the director must keypunch an input card with a decision message in the following form:

$CODE/=DM/a, b, c, d, .....

1. The first item of information in the line ($CODE) is one of 15 general decision codes. This code tells the general type of decision being made. In CITY MODEL a dollar sign ($) is the first symbol in all general decision codes. The general decision codes are:

| | | Govt. | Soc. | Econ. | Dir. |
|---|---|---|---|---|---|
| a. | $PU | x | | x | |
| b. | $CVPT | x | | x | x |
| c. | $OTHER | x | | x | x |
| d. | $OUBLD | x | | x | |
| e. | $BUILD | x | | x | |
| f. | $CASH | x | | x | x |
| g. | $TIME | | x | | |
| h. | $BYCT | | x | x | |
| i. | $VALUE | x | x | | |
| j. | $TAXES | x | | | |
| k. | $ASMNT | x | | | |
| l. | $REDIST | x | | | |
| m. | $FSA | x | | | |
| n. | $ROUT | x | | | |
| o. | $RAIL | x | | | |
| p. | $HDNG | | | | x |

2. A slash sign (/) always follows the decision code.

3. The second item of information for a decision is the identification of the decision-maker. An equal sign (=) is used to preface the decision-maker identification code. The decision-maker codes are:

A . . . Economic -- number of teams

AA . . . Social -- number of teams

CH1 . . . Chairman -- number of jurisdictions

AS1 . . . Assessment -- number of jurisdictions

SC1 . . . School -- number of jurisdictions

MS1 . . . Municipal Services -- number of jurisdictions

PZ1 . . . Planning and Zoning -- number of jurisdictions

UT1 . . . Utility -- number of jurisdictions

HY1 . . . Highway -- number of jurisdictions

BUS . . . Bus Company

RAIL . . . Rapid Rail Company

OU . . . Outside -- Used by the game director

4. The decision-maker code is followed by a (/).

5. The remaining information concerning the decision is printed after the second slash and is separated by commas. The blank spaces are ignored in the decision-information. For example, the following information is identical to the computer:

**$CV**PT/ =A / S, 72 40, 26, 51, 102

$CVPT/=A/S, 7240, 26, 51, 102

The information following the second slash varies by the type of decision. For the following explanations assume the format:

$CODE/=DM/2, b, c, etc.

here "a" is the first item of information after the second slash, "b" is the second item of information, etc.

The general decision codes that can be used to make more than one type of specific decision require that a specific decision code be placed in the "a" space. The general and specific codes are summarized below:

| | General Code and Meaning- | Specific Code and Meaning |
|---|---|---|
| 1. | $PU<br>purchase land and/or developments | None |
| 2. | $CVPT<br>change existing conditions on location-specific items | R - change rents<br>P - change prices<br>S - change business salaries<br>M - change maintenance level of public and private developments |

| General Code and Meaning | Specific Code and Meaning | |
|---|---|---|
| | E | - change employment at a school or municipal service location |
| | C | - award contracts to BG and BS by school or municipal service department |
| | US | - change or add utility service to a parcel of land |
| | Z | - change zoning on a parcel |
| | PLND | - add preempt land |
| | RPLND | - replace preempt land |
| 3. $OTHER change conditions for non-location specific items | LO | - take a loan from another team (only the borrower) |
| | BO | - take a loan from the outside by a private team or a government department |
| | SP | - invest in speculative stocks |
| | SELLSP | - sell speculative stocks |
| | CN | - invest in conservative stocks |
| | SELLCN | - sell conservative stocks |
| | W | - set the welfare payment per unemployed worker |
| | S | - change salaries for SC, MS, BUS or RAIL department jurisdiction-wide |
| | M | - change maintenance level of a highway type for an entire jurisdiction or of bus or rail equipment. |
| | P | - change the price of utility service for a jurisdiction or fare for bus or rail |
| | PS | - purchase bus or rail rolling stock |
| | SS | - sell bus or rail rolling stock |
| | NOCI | - play without a local CI |
| | YESCI | - play with local CI |
| | INLO | - move in a specified number of PL's via the migration routine |
| | INMID | - move in a specified number of PM's via the migration routine |
| | INHI | - move in a specified number of PH's |
| 4. $OUBLD have an outside construction firm build a private or public development | None | |

| | General Code and Meaning | Specific Code and Meaning | |
|---|---|---|---|
| 5. | $BUILD<br>have a local construction firm build a private or public development | None | |
| 6. | $CASH<br>transfer cash from one account to another | C | - transfer of cash from other than the chairman's account |
| | | CP | - appropriate capital funds |
| | | CR | - appropriate current funds |
| | | CURS | - grant a current subsidy |
| | | CAPS | - grant a capital subsidy |
| | | SB | - grant a subsidy to an economic team |
| 7. | $TIME<br>allocate the leisure time for population units | H | - for high income class |
| | | M | - for middle income class |
| | | L | - for low income class |
| 8. | $BYCT<br>boycott working, shopping, or using public transit | S | - social boycott (by population units) |
| | | E | - economic boycott (businesses) |
| 9. | $VALUE<br>change the dollar value of time for population units | H | - for high income class |
| | | M | - for middle income class |
| | | L | - for low income class |
| 10. | $TAXES<br>change tax rates for various bases | L | - assessed value of land |
| | | D | - assessed value of developments |
| | | RI | - income earned by residents of jurisdiction |
| | | EI | - income earned by those employed within the jurisdiction |
| | | RA | - auto expenses of residents of the jurisdiction |
| | | EA | - auto expenses of those employed within the jurisdiction |
| | | G | - total value of BG and PG sold by stores in that jurisdiction |
| | | S | - total value of BS and PS sold by stores in that jurisdiction |

| | General Code and Meaning | Specific Code and Meaning | |
|---|---|---|---|
| 11. | $ASMNT<br>make changes by the assessment department | UL | - jurisdiction-wide assessment ratio for all undeveloped, non-farm land |
| | | DL | - jurisdiction-wide assessment ratio for land on all developed parcels |
| | | FR | - jurisdiction-wide assessment ratio for all farm land |
| | | AD | - development assessment ratio for specific parcel |
| | | AL | - land assessment ratio for specific parcel |
| | | AF | - farm assessment ratio for specific parcel |
| | | SD | - assessed dollar value for development on a specific parcel |
| | | SL | - assessed dollar value for land on a specific parcel |
| | | SF | - assessed dollar value for land on a specific farm parcel |
| 12. | $REDIST<br>change district boundaries for SC or MS | | None |
| 13. | $FSA<br>request federal-state aid by department | | None |
| 14. | $ROUT<br>change levels of service and routes for bus and rail operation | | None |
| 15. | $RAIL<br>build rail lines and rail stations | | None |
| 16. | $HDNG | | None; however the $HDNG card must be followed by a card with desired heading punched on it. The whole card can be used for heading. |

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Transfer | $CASH | OU or economic decision-maker or department and jurisdiction | C | receiver (economic decision-maker or OU or department and jurisdiction | amount in dollars | giver's account (PVT or if department CAP or CUR) | receiver's account (PVT or if department CAP or CUR) | |
| Float Capital Bonds | $OTHER | department receiving | BO | amount in $10,000's | 25 | | | |
| Economic Price Change (Outside input limits check) | $CVPT | economic decision-maker | P | location | basic price per CU in $100 | 0 | 0 | A if new price is to be accepted |
| Economic Salary Change (Outside input limits check) | $CVPT | economic decision-maker | S | location | salary per low-income worker in $100's | salary per middle-income worker in $100's | salary per high income worker in $100's | A if new salaries are to be accepted |



CITY MODEL
DIRECTOR'S SUMMARY INPUT EXPLANATION FORM
(normal scale)

CITY MODEL - DIRECTOR'S SUMMARY INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Utility Price Change (Outside input limits check) | $OTHER | UT1, UT2 or UT3 | P | new price per unit of utility service | 1 if new price is to be accepted | | | |
| Change School Salaries (Outside input limits check) | $OTHER | SC1, SC2 or SC3 | S | salary per middle income worker in $100's | salary per high income worker in worker in $100's | 0 | A if new salary is to be accepted | |
| Change MS salaries (Outside input limits check) | $OTHER | MS1, MS2 or MS3 | | salary per low-income worker in $100's | salary per middle income worker in $100's | 0 | A if new salary is to be accepted | |
| Assure Land Purchase | $PU | Decision-maker bidding | location | price in $100's | OU | percent of parcel (0 if all) | 1 to insure bid success | |
| Create Preempt Land | $CVPT | OU | PLND | location | percent of parcel to be added to undevelop-able | | | |

CITY MODEL - DIRECTOR'S SUMMARY INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Remove Preempt Land | $CVPT | OU | RPLND | location | percent of parcel to be taken out of undevelopable | | | |
| Forbid Construc-tion Industry | $OTHER | OU | NOCI | | | | | |
| Allow Construc-tion Industry | $OTHER | OU | YESCI | | | | | |
| Specify Number of In-Migrants | $OTHER | OU | INLO, INMID, INHI | number of Pl's to inmigrate | | | | |

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Transfer Cash | $CASH | OU or economic decision maker | C | receiver (economic decision-maker or OU or department and jurisdiction) | amount in dollars | giver's account (PVT or if department CAP or CUR) | receiver's account (PVT) or if department CAP or CUR) | |
| Float Capital Bonds | $OTHER | department receiving | BO | amount in $1,000's | 25 | | | |
| Economic Price Change (Outside input limits check) | $CVPT | economic decision maker | P | location | basic price per CU in $10's | 0 | 0 | A if new price is to be accepted |
| Economic $ Salary Change (outside input limits check) | CVPT | economic decision maker | S | location | salary per low income worker in $100's | salary per middle income worker in $100's | salary per high income worker in $100's | A, if new salaries are to be accepted |



CITY MODEL
DIRECTOR'S SUMMARY INPUT EXPLANATION FORM
(small scale)

CITY MODEL DIRECTOR'S SUMMARY INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Utility Price Change (Outside input limits check) | $OTHER | UT1, UT2, or UT3 | P | new price per unit of utility service | 1 if new price is to be accepted | | | |
| Change School salaries (outside input limits check) | $OTHER | SC1, SC2 or SC3 | S | salary per middle income worker in $100's | salary per high income worker in $100's | | | |
| Change MS salaries (outside input limits check) | $OTHER | MS1, MS2, or MS3 | S | salary per low income worker in $100's | salary per middle income worker in $100's | | | |
| Assure Land Purchase | $PU | decision-maker bidding | location | price in $100's | OU | Percent of parcel (0 if all) | 1 to assure bid success | |
| Create Preempt Land | $CVPT | OU | PLND | location | percent of parcel to be added to undevelopable | | | |

CITY MODEL DIRECTOR'S SUMMARY INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Remove Preempt Land | $CVPT | OU | RPLND | location | percent of parcel to be taken out of undevelopable | | | |
| Forbid Construction Industry | $OTHER | OU | NOCI | | | | | |
| Allow Construction Industry | $OTHER | OU | YESCI | | | | | |
| Specify In-Migrants | $OTHER | OU | class and jurisdiction INLO, INMID, or INHI | number Pl's to in-migrate | | | | |

# APPENDIX D

## EDITS

APPENDIX D: Edits

The listing of the director and player input decisions and the EDIT Program generated diagnoistics of the decisions comprise what is called the edits. This appendix contains an explanation of all the messages which could appear in the edits. Familiarity with this appendix will enable the director to suggest the reasons for decision rejections.

If and only if an input decision is in error will an error message be generated. The absence of any message (except in the cases of federal-state aid requests, auctions, redistricting and bonding) indicates that the decision has been accepted and its changes incorporated into the data base. The edits are listed in the same order as they are inputted. Additional diagnostics concerning bids on parcels up for auction, federal-state aid requests, and school and municipal services redistricting attempts* are printed as the final part of the edits.

The description of edits will be presented in the following order:

1. General Error Messages (for inputs that have been rejected because of formatting errors or because of improper team, location, or land use identification).

2. $BUILD and $OUBLD Error Messages (for inputs that relate to local and outside construction of private and public land uses).

3. $CASH Error Messages (for inputs to transfer funds, make appropriations, and grant subsidies).

4. $PU (Purchase) Error Messages (for inputs to bid on auctioned or toher outside-owned land or to acquire property from another team).

5. $OTHER and $CVPT Error Messages (for inputs to change conditions that are non-location specific and location specific).

6. $TAXES Error Messages (for inputs to change tax rates applied to various tax bases).

7. $FSA Error Messages (for inputs to request Federal-state aid for capital expenditures by department).

8. $REDIST Error Messages (for inputs to create and change boundaries for SC or MS districts).

---

*These inputs are collected and processed as the final action of the EDIT program.

9. $RAIL Error Messages (for inputs to build rail lines and rail stations).

10. $ROUT Error Messages (for inputs to change service levels and routes for the Bus and Rail Departments).

11. $TIME Error Messages (for inputs to change the time allocation for population units by class and/or parcel).

12. $BYCT Error Messages (for inputs to make economic or social boycotts).

13. $VALUE Error Messages (for inputs to change the dollar value of time units spent travelling).

14. $ASMNT Error Messages (for inputs to change assessment rates and to establish new assessed values).

15. The Concluding Messages (remarks on land auction, redistricting, and Federal-state aid requests).

1. General Error Messages

For all general errors, an indicator ( Δ ) points to the approximate location of the error.

a. INVALID $ ENTRY

Incorrect general decision code. All subsequent decisions using this $ entry will be invalidated.

b. INVALID TEAM ENTRY

Mistake in the team identification in the decision-maker location of the input card. Might be caused by omitting second slash or mispuncing "=".

c. NO CURRENT VALID $ ENTRY

No valid general decision code has been entered or the last one entered is in error. Usually will occur after a #1 error.

d. NO CURRENT VALID TEAM ENTRY

No valid team identification has been entered in the decision-maker location of the input card or the last one entered is in error.

e. NO RIGHT PARENTHESIS

In the right hand parenthesis for an input requiring one has been omitted. All lists, and only lists, must be enclosed in parentheses.

f. INVALID LOCATIONS LIST

Mixing of parcel (even-even), intersection (odd-odd) and road locations (even-odd or odd-even) on the same list.

g. INCORRECT PUNCTUATION

Indicator points to incorrect punctuation. Examples: comma(,), clash(/), etc.

h. INVALID LAND USE*

Use of the wrong abbreviation for the land uses in the model.

i. INVALID TEAM*

Mistake on the specification of a team identification elsewhere in the decision-maker location on the line.

j. MORE THAN 15 CHARACTERS

Might result if commas were omitted from the input card.

k. NUMBER TOO HIGH

Too large of a number has been input. Check input explanation form to see if scaling has been observed.

l. NUMBER TOO HIGH OR TWO LOW

The entered number is not within the prescribed limits of this particular entry. Normally, a fifty percent variation around typical values is permitted.

---

*Errors in letters h, i, m and o often occur when data is coded in the improper column. The EDIT Program expects certain designations (team letter, land use code, etc.) in specific places. When an input has the columns wrong, errors h, i, m or o will occur.

m. INVALID CHARACTER IN NUMBER*

An extraneous character has been added to a number. This could be a dollar sign for a land bid or price. Note that all figures are coded without commas.

n. LIST NOT PERMITTED

Parentheses have been used to include several entries where only one entry is allowed. Be careful on $RAIL and $ASMNT decisions.

o. INCORRECT LOCATION ENTRY*

Not a valid location on the board or use of a parcel, road, or intersection for that type of decision.

p. BLOCK ENTRY NOT PERMITTED

Opposite corners used to specify a zone when a zone is not permitted. Another way to put it is that in this list the character " > " is invalid.

q. INVALID ROAD COORDINATES

Will only accept even-odd or odd-even combinations that are on the board.

r. MORE THAN 65 LOCATIONS IN LIST

Input of a zone or district in a total line entry that is too large, i.e., exceeds 65 locations.

s. MORE THAN 15 ENTRIES IN NONLIST

This message indicates a program error.

2. $BUILD and $OUBLD Error Messages

a. LEVEL ERROR

Old and new levels are the same of the new level is too high.

---

*Errors in letters h, i, m and o often occur when data is coded in the improper column. The EDIT Program expects certain designations (team letter, land use code, etc.) in specific places. When an input has the columns wrong, errors h, i, m or o will occur.

b. (team name) CANT BUILD LAND USE

Some sort of build that is not allowed by government or economic team.

c. QI (quality index) ERROR

A quality index less than 40 or more than 100.

d. ONLY RA'S CAN HAVE PRIVATE UTILITIES

If private utilities are attempted for a build of RB or RC housing, the build will be rejected.

e. WRONG ROUTINE

Use of RAIL as a decision-maker or contractee on a build decision code. (Rails are built using $RAIL) or use of $BUILD to construct a utility plant.

f. LOCATION ERROR

Trying to build something like a road on a parcel or intersection on a road, or a terminal on a parcel or along a road.

g. COST TO (team name) FOR BUILD ON (location) IS $ (price) ONLY HAS $ (capital balance).

Rejects build for teams with insufficient funds.

h. (team name) OWNS (location)

When wrong owner of the location has been specified.

i. (number) % OF (location) IS REQUIRED, - ONLY (number) % IS AVAILABLE.

Not enough land is available for that type of construction.

j. (land use) AT (location) IS LEVEL (number).

Old level has been incorrectly specified.

k. (location) IS ZONED (number) WHICH PROHIBITS (land use)

Indicates zoning conflict.

l. O (land use) ON (location)

Try to upgrade or demolish something that is not there.

m. REQUIRES LEVEL (number) UTILITY SERVICE - ONLY HAS LEVEL (number).

Inadequate utility service.

n. EXCEEDS UTILITY PLANT CAPACITY

Maximum of 2400 units per level of utility plant can be consumed.

o. REALLOCATION OF SERVICE MUST PRECEDE DEMOLITION

If a utility plant is reduced to zero, all assigned service must be first reallocated.

p. UNITS CONSUMED MUST BE DECREASED TO (number) BEFORE DEMOLITION.

To reduce level or levels of a utility plant the number of units served by the plant must be:

1. Less than or equal to 4800 if the reduction is to a UT2.

2. Less than or equal to 2400 if the reduction is to a UT1.

q. (UT or CI) ONLY BUILT OUTSIDE

Neither utility plants nor construction industries can be built by local firms, i.e., $BUILD is an invalid decision code for these two land uses.

r. THERE IS NO JURISDICTION (number)

An incorrect number has been placed in the jurisdiction field.

s. (location) IS NOT A CI IT IS A (land use)

When location specified for the CI does not actually have a CI on it; this mistake most often occurs when the location of parcel intended for construction is specified in column A.

t. (team name) OWNS CI AT (location)

Wrong owner of the CI has been specified. Recall the decision-maker for a $BUILD input is the owner of the CI (contractor).

u. (location) IS IN JURISDICTION (number)

Government department tries to build in wrong jurisdiction or Highway Department did not specify other jurisdiction involved in a road along a boundary.

v. JURISDICTION (number) IS RESPONSIBLE FOR (highway location) - upgrading a highway along boundary by jurisdiction other than the jurisdiction that built the highway.

w. JOB EXCEEDS (CI Location)'s CAPACITY (number which is the equipment units required for that build)/(number of design capacity equipment units uncommitted).

Shows that the remaining design capacity of the CI was insufficient to complete this job.

x. (location) HAS CONTRACT

Only one CI may be used for two private construction contracts on the same parcel.

3. $CASH Error Messages

a. (input) IS NOT A VALID CODE

If the wrong secondary code is used.

b. AS HAS NO CASH

If you try to transfer cash to or from Assessment Department.

c. FOURTH ENTRY (or FIFTH ENTRY) MUST BE CAP OR CUR

Cash transfers from or to a department must indicate which account. No department has a private (PVT) account.

d. (team; PZ or CH) HAS ONLY A (CAPITAL OR CURRENT) ACCOUNT

The chairman only has current account and PZ has only capital account. Remember: column D tells the account <u>from</u> which the cash is coming; column E tells <u>to</u> whom it is going.

e. ONLY CHAIR MAY USE (code)

Only the Chairman may use other than the C code in column A.

f. (team) DOES NOT RECEIVE APPROPRIATIONS

Neither economic teams, UT, BUS, RAIL nor CH receive appropriations. Cash transfers may be used.

g. NOT AN APPROPRIATION - DIFFERENT JURISDICTION

One cannot transfer money across jurisdiction with use of appropriation. Cash transfer may be used.

h. WRONG SUBSIDY

If in column A you try SB to subsidize a department or CAPS or CURS to subsidize an economic team.

i. (team) DOES NOT RECEIVE SUBSIDY

Only economic teams, Utility, Bus, or Rail Departments can receive subsidies.

j. NULL TRANSACTION

Cannot transfer money within the same account.

k. (team) ONLY HAS (amount)

If attempt is made to transfer more money than is in the running account. Remember that inputs preceding this one have already been processed. On the other hand, inputs following this have yet to be processed.

Note: Money may not be transferred to or from social accounts.

4. $PU (purchase) Error Messages

a. OUTSIDE DOES NOT BUY LAND

If you try to have OU purchase (i.e., OU as the decision-maker)

b. BUS CANNOT OWN LAND

The Bus Department may not acquire land.

c. DIFFERENT AREAS

If departments in different jurisdictions attempt to transfer land (this is checked before the checks represented by letters g and h below).

d. ONLY DEPARTMENT SELLS PART TO PRIVATE

Private buyer always has to put a 0 in column D or leave it blank.

e. (team) OWNS (location)

Incorrect owner specified.

f. (x%) REQUIRED - ONLY (y%) AVAILABLE

Seller does not own as much of the parcel as the departmental decision-maker requested.

g. (location) IS IN (jurisdiction number)

Department must purchase only within its won jurisdiction boundaries.

h. (OU) CAN ONLY SELL 0 ON (location)

If economic team bids on a parcel where 100% is consumed by preempt and/or government owners.

i. (location) IS IN JURISDICTION (number)

Jurisdiction specified for seller (column C) is not of the location (from the seller's point of view).

j. (location) COST $ (amount) - (team) ONLY HAS $ (amount)

Team must have sufficient cash to purchase land.

5. $OTHER and $CVPT Error Messages

The following functional codes are used as part of the following error messages:

RENT - set rents

EMPLOY - hire part-time workers or employ population units

MAINTN - set maintenance levels

PRICE - establish prices

CNTRCT - contract to purchase BG and/or BS

ZONING - change zoning

WELFRE - set welfare payments

EDUCAT - operate adult education

UTSERV - establish utility service

INVEST - purchase or sell conservative or speculative investments

BORROW - borrow money from outside system

STOCK - purchase or sell rolling stock

On loans and bonds that are successfully floated, the following message is printed which indicates the interest rate to be paid:

INTEREST IS (percent)

The First Nine Messages Apply to Director Inputs Only.

a. THERE IS A CI AT (location)

If NOCI is input and there is a CI on the board.

b. USE $CVPT FOR (specific decision-code)

If $OTHER is used when PI(RPT) or PLND (RPLND) is being input.

c. (PI or PLND) REQUIRES SPECIFICATION OF PERCENT OF PARCEL

If there is either no or zero specification of percent of parcel for PI or PLND decision.

d. (location) IS IN (number of jurisdiction)

If a PI or RPI decision and decision-maker is not in the correct jurisdiction.

e. (number) % IS REQUIRED - ONLY (number) % IS AVAILABLE

There is less land available for PI or PLND than the input specified.

f. PI (or RPI) COSTS $ (amount) - PZ (number) ONLY HAS $ (amount) CAPITAL FUNDS

PZ Department has insufficient cash to carry out the transaction involving public institutional land.

g. THERE IS NO PI ON (location)

If an attempt is made to remove PI and no PI exists at that location.

h. NO MORE PI

If PI and there are already 45 parcels with PI on them, i.e., the maximum has been reached.

i. ONLY (number) PERCENT OF (location) IS (PI or PLND)

If an attempt is made to remove more PI or PLND than presently are on that parcel.

"Function" appearing in parentheses indicates that one of the functional codes listed above will appear in that position of the edit message.

j. EA IS AN INVALID CODE

If team other than SC tries to make decisions for adult education. This refers to the secondary code appearing in column A.

k. TEAM (name) DOES NOT (function)

Indicates that the particular team may not perform this function.

l. (entry) IS AN INVALID CODE

If the specific decision code is not a valid code.

m. USE $OTHER, -- (team name) SPECIFIED (function) SYSTEMWIDE

If $CVPT is used when $OTHER is appropriate. Recall that $CVPT is only used when making a decision for a specific location.

n. (team) SPECIFIES (function) BY LOCATION

If $OTHER is used when $CVPT is appropriate.

o. (team name) (function) IS TOO (HIGH or LOW)

If maximum or minimum is exceeded for $CVPT inputs.

p. (function) AT (location) IS TOO (HIGH or LOW)

If maximum or minimum is exceeded for $CVPT inputs.

q. LOCATION ERROR

If intersection or road location is input when parcel is expected.

r. (location) IS A (land use) AND DOES NOT (function)

The land use on that parcel does not perform the indicated function. This error most often occurs when an economic decision-maker attempts to set a price for an HI, LI, and/or NS.

s. (location) HAS NO ATTACHMENT

Program error: please notify Environmetrics

t. (location) MAINTENANCE SET TO MAXIMUM -- (number)

Maintenance level is set to the maximum possible: twenty points above the lowest QI ever reached for a residence.

u. (function) AT (location) IS TOO (HIGH or LOW)

Picks out which locations on a list have exceeded the limits.

v. THERE IS NO (SC or MS) AT (location)

When maintenance or employees are set for a location at which no appropriate development exists.

w. (location) IS IN (jurisdiction number)

If SC or MS decisions are made in the wrong jurisdiction.

x. JUST ONE PRICE

If more than one price is given for utility service.

y. ZONE OR MILE

If the bus or rail department inputs both a zone and per mile fare; only one may be specified.

z. (number) IS NOT A ROAD LEVEL

If road maintenance is specified for other than 1, 2, or 3 level.

a-1. ONLY (number) SALARY(S)

SC and MS hire one class. This message shows the number of salaries that should have been input by the department.

a-2. (team) OWNS (location)

If the team specified does not own the location of the BG or BS for a contract input.

a-3. (team)'s (land use) AT (location) HAS NO CONTRACT WITH (department)

If the location is not a BG or BS or there was no contract to begin with in the case that the decision-maker was attempting to eliminate a contract.

a-4. ONLY PZ CAN ZONE

If some other decision-maker attempts to zone.

a-5. (number) IS NOT A ZONING CODE

If invalid zoning code is used.

a-6. ONLY PZ (jurisdiction) CAN REZONE (location)

If a jurisdiction tries to zone a location in that jurisdiction.

a-7. CANT CHANGE (location)

If you try to reallocate service for a parcel that has a utility plant on it.

a-8. (parcel location EXCEEDS (plants) CAPACITY

Limits of 12700 units installed or 2400 units served from any level utility plant have been exceeded.

a-9. (location) USES MORE THAN LEVEL (number)

Try to reduce service on a parcel below what is needed by the development already on the parcel.

a-10. UT (jurisdiction number) ONLY HAS $ (amount)

If utility department does not have enough money to build all or part of new utility service extensions.

a-11. NONCONNECTABLE (location)

Lack of contiguity or lack of funds to provide the attempted extension of utility services.

a-12. NO UTILITY PLANT ON (location)

Wrong location given (in column C). Often columns B and C are reversed on the player's input decision form.

a-13. (number) NOT A UTILITY LEVEL

Only accepts the digits 0 through 9 as valid utility levels.

a-14. PAYMENT IS TOO HIGH

If welfare is specified as greater than 100 (i.e., $10,000 per unemployed worker)

a-15. (CH or PZ DOES NOT GET (2 or 25) YEAR BONDS

If CH tries to acquire a current bond for PZ or a capital bond for himself.

a-16. ALREADY 21 BONDS

If there are already 21 bonds for a single department.

a-17. SCALE BOND IN 10,000'S

If bond for more than $3 billion is input. This points out that the decision-maker probably forgot to scale his input amount.

a-18. BOND OF $ (amount) EXCEEDS DEBT LIMIT OF $ (amount) PRESENT DEBT IS $ (amount)

If debt limit for a particular department is exceeded.

a-19. USE BONDING ROUTINE

If LO (column A) is used for a government department.

a-20. USE CODE (LO or BO)

If BO (column A) is used with a team as the lender or LO is used with no team specified as the borrower.

a-21. ONLY 2 OR 25 FOR TERM

If a term of other than 2 or 25 years is specified (column C for BO: D for LO)

a-22. INTEREST NONNEGOTIABLE

If an interest rate on a BO decision is specified.

a-23. LOAN MAY NOT BE MADE - 14 MADE ALREADY

If there are already the maximum of 14 loans granted by the decision-making team.

a-24. (amount) LOAN EXCEEDS LIMIT OF (amount that can still be borrowed) TOTAL DEBT LIMIT IS (amount) - PRESENT DEBT IS (amount)

The economic team loan is larger than the amount that can be borrowed.

a-25. (team) ONLY HAS $ (amount) IN (CONSERVATIVE or SPECULATIVE) INVESTMENTS

If attempt is made to sell more in stocks than a team has.

a-26. INVEST COSTS $ (amount) - (team) ONLY HAS $ (amount) IN CAPITAL FUNDS

If team tries to invest more money in stocks than it has available in cash.

6. $TAXES Error Messages

a. (number) EXCEEDS TAX MAXIMUM OF 99

If a tax rate of too many mils is entered. This maximum tax rate of 9.9% can be exceeded by placing a "1" in the final position on the input card.

b. ONLY CH1, CH2, or CH3 CAN ENTER TAXES

If some illegal team entry is made.

c. L, D, RI, EI, RA, EA, G OR S

If some code (column A) other than the ones listed is entered.

7. $FSA Error Messages

a. ERROR IN FSA DATA - TEAM, LEVEL, TYPE, N, LOCS (and then repeats the line of input data)

This message is printed for any input errors when requesting federal-state aid.

8. $REDIST Error Messages

a. (team) CANNOT REDISTRICT

If wrong team identification is used. Only MS and SC departments may redistrict.

b. (location) IS IN JURISDICTION (number)

The specified parcel is not in the jurisdiction of the decision-maker (MS or SC).

c. (location) HAS NO (MS or SC)

If no SC or MS is on the parcel to which the district is being assigned. If a new plant is being constructed you cannot redistrict until the EDIT preceding the round in which the plant will appear.

9. $RAIL Error Messages

a. (team) CANNOT ENTER RAIL INPUT

If other than RAIL is used as the decision-maker

b. RAIL IS NOT FEASIBLE IN THIS SIZE CITY

If rail decisions are made in the CITY MODEL when a population unit equals 50 people (small scale).

c. LIST MUST BE OF PARCELS

Land list (column C - track construction input) must contain even-numbered coordinates.

d. (entry) IS NOT A VALID INTERSECTION

Not on the board or it contains an even-numbered coordinate.

e. RAIL ONLY HAS $ (amount) - NO STATION BUILT AT (location)

If the department does not have enough money to pay for the station construction.

f. ONLY (number) MORE TRACK SECTIONS MAY BE BUILT

3955 is the most segments possible and as you get within 500, this message prints. If no (zero) more track sections can be built then the inputs are rejected.

g. NO RR LAND IS UNUSED AT (location)

No land available on parcels designated to supply land for track rights-of-way.

h. LACK OF PARCEL (location) HAS PREVENTED RR CONSTRUCTION

If you require land from a parcel but do not list that parcel or contributing land.

i. RR CONSTRUCTION COSTS $ (amount) - RAIL HAS $ (amount)

If department does not have enough cash for track construction.

j. RAILROAD NOT BUILT BETWEEN (intersection) AND (intersection)

This message prints anytime that a rail segment is not built.

10. $ROUT Error Messages

a. *** BUS OR RAIL NOT SPECIFIED

Only Bus and Rail may make decisions concerning routes.

b. NEW ROUTE, OLD LEVEL NOT ZERO OR NEW LEVEL NOT ZERO

If where a new route is specified the old level is not designated as zero or if you try to eliminate a route that does not exist.

c. ALREADY 32 ROUTES

Maximum sum of bus and rail routes is 32.

d. ERROR MORE THAN 31 stops or no road

There cannot be more than 31 stops on a route. No bus route over a road bed may be specified.

e. NO TRACKS BETWEEN (intersection) AND (intersection)

If a rail route is specified where no tracks exist.

f. NO STA. OR TRACK AT INT. (intersection location)

If you specify that a route stops at an intersection with no station.

g. ERROR IN LEVELS

If the old level specified is not the actual level of that route.

11. $TIME Error Messages

a. ONLY PVT ALLOCATES

Only a social decision-maker can input a time allocation decision.

b. ONLY L1, L2, L3, M1, M2, M3, H1, H2, OR H3

These population unit codes by jurisdiction are the only ones allowed (column A)

c. HI CANT ALLOCATE FREE SCHOOL

If time for a PH has been allocated to free education (column B).

d. TIME ADDS TO (total of units if over 100)

Rejects an input if an allocation of more than 100 time units was attempted.

e. LOCATION ERROR

If intersection or road segment is input as a location for P1's.

f. (team) DOES NOT CONTROL (H, M, or L) ON (location)

If a team attempts to make time allocation decisions for a class on a parcel over which it does not have control.

g. THERE ARE NO (H, M, L)'S ON (location)

If time is allocated for a class of P1's on a parcel where no members of that class reside.

h. (location) IS IN (jurisdiction number)

If the specified location is not in the jurisdiction indicated by the number after H, M or L (column A).

12. $BYCT Error Messages

a. (location IS (UNDEVELOPED or a RESIDENCE)

If a boycott is attempted at a location which is either undeveloped or a residence.

b. (location IS A (land use)

If shopping boycott is attempted at a location with a land use that does not sell.

c. ONLY 44 BOYCOTTS

Maximum of 44 boycotts is allowed in the entire system.

d. (team)'S (class or land use)'S ARE NOT BOYCOTTING (SHOP, WORK, or USE) (location)

If you attempt to stop a boycott that does not exist. Remember S in column E means stop, not start.

e. (team)'S (class or Land use)'S ARE ALREADY BOYCOTTING (SHOP, WORK, or USE) - (location)

f. (department) DOES NOT HIRE

Try to boycott work at a department that does not hire population units.

13. $VALUE Error Messages

a. (team) DOES NOT SET TIME VALUE

If a non-social decision-maker is listed.

b. L, M, OR H

If column A does not contain either L, M, or H.

14. $ASMNT Error Messages

a. (entry) IS NOT A RECOGNIZABLE CONTROL WORD

The wrong code has been used.

b. IT IS TOO LATE TO ENTER (entry) -- USE OOPS AND START ALL OVER

If a decision at a higher level of application was made after a lower level decision had been input. For example, using the L cde after LHI was used.

c. SOMEONE ON TEAM (team name) IS TRYING TO ENTER ASSESSMENT INPUT

Some illegal decision-maker code was used.

d. (location) CANNOT BE ASSESSED

If a special assessment is attempted for an non-privately-owned parcel.

e. DATA ITEM (item) IS NONSENSE or LOCATION ERROR

If location specified is off the baord, intersection, or road segment or if assessment rate is greater than 1000 mils (100%).

f. ZONE (number) IS EMPTY BUT MAY BE EXTENDED

If a dummy zone is intentionally specified or if a zone with no parcels within it (the same intersection was listed twice as the boundaries of the zone) is accidently specified.

g. (location) IS IN (jurisdiction number)

If a special zone or a special assessment deals with land outside the proper jurisdiction. If the error is for a special zone, the further message is ZONE REJECTED.

h. ZONE (number) HAS NOT YET BEEN DEFINED

If a zone is specified to have the same characteristics as another zone, which has yet to be defined.

i. NO PARCEL LIST FOR ASSESSMENT

A location has not bee specified in column "c" for a type of assessment decision which requires a location (AD, AL, SL, SD).

j. UNNECESSARY PARCEL LIST FOR ASSESSMENT

A location has been specified in column "c" for a jurisdiction-wide decision setting the assessment ratio of a land use.

k. (code) IS NOT A RECOGNIZABLE CONTROL WORD

An incorrect letter code has been used.

l. (location) IS NOT A FARM PARCEL

A farm assessment has been inputted for a parcel which is not part of farm.

m. AN INTERNAL ERROR

A program error.

15. The Concluding Messages

As was mentioned earlier, the final Edit messages for bids on auctioned parcels of land, federal-state aid requests, and redistricting errors are printed at the end of all the other edit messages. They appear as shown on the following page.

a. Auctioned Parcels

The following is a sample output:

```
                          ******  END OF INPUT DATA  ***
B    'S    $    102000 BID ON 11818 ACCEPTED   .2402  /  .8580
C    'S    $     51000 BID ON 11426 REJECTED   .7743  /  .1790
A    'S    $      5100 BID ON 11426 REJECTED   .6653  /  .0000
B   OWNS 7430
F    '     $   184620 BID ON   8838 REJECTED   .6583  /  .2649
```

Note that B's bid was accepted. This is because the probability of B's bid being accepted (the number to the right of the "/") was greater than a randomly drawn number (the number immediately to the left of the "/"). The bids by C, A and F were rejected because the probabilities generated by the amount of money they bid were less than randomly drawn numbers. Some team made a bid for parcel 7430 but team G had already purchased that auctioned parcel by bidding more than the asking price.

b. Federal-State Aid

The second part of the final messages is a list of federal-state aid data in the following format (the numbers are for purposes of illustration only assuming a two jurisdiction area).

| JUR. | STUDENTS | SCHOOL | POPULATION | PARKS |
|---|---|---|---|---|
| 1 | 34040 | 2 | 252 | 99 |
| 2 | 28610 | 2 | 299 | 111 |
| 3 | 0 | 0 | 0 | 0 |

For jurisdiction 1, there are 34,040 students, two levels of schools, 252 population units and 99 units (1/25 of a square mile) of parkland.

Then each of the individual requests are listed (in order of HY, PZ, and SC) and if the aid was grated this is indicated. In the case of each request, the number following the word "chance" is the probability that the aid will be received. Sample messages are:

FOR HYWAY FROM 10922 TO 10935 CHANCE .50

REQUEST GRANTED (if aid request is approved, and no message if the request is rejected).

25.0% CHANCE FOR AID OF $ 50000 FOR PZ1

REQUEST GRANTED (if aid request is approved, and no message if the request is rejected).

*c. Redistricting Error Messages

If any part of the redistricting of a department in a jurisdiction is invalid, then all redistricting by the department in that jurisdiction is rejected. The message which appears is:

PROPOSED REDISTRICTING RESULTS IN DISTRICT FOR (SC or MS) AT (location) BEING DISCONTINUOUS (SC or MS) REDISTRICTING REJECTED FOR JURISDICTION (number)

There is no redistricting message at the conclusion of the edits if no errors were made.

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*See page 135 of Appendix G for an explanation of how redistricting inputs are processed.

# APPENDIX E

## MAXIMUMS AND MINIMUMS IN THE CITY MODEL INPUTS AND FILES

APPENDIX E: Maximums and Minimums in the City Model Inputs and Files

The game director should be aware of a few constraints that have been placed on the size of inputs and the size of growth that the model can handle. Some of these maximums have been imposed by the lack of computer space and others are practical limits that should never be achieved. The maximums fall into two classes -- those related to input constraints and those related to the number of pieces of data that can be associated with a particular item (a file maximum) an example of the first type of constraints is that no value greater than $500 can be inputted for the dollar value of time. An example of the second type or file constraint is that no more than 63 schools may be built. The director should also note input minimums.

In addition to including EDIT program input restrictions, the manner in which the director may override some of these restrictions is illustrated in Section C of this appendix. An appendix (*) before an input maximum/minimum listed in Section A denotes that this input restriction can be overridden.

1. Input Maximums/Minimums

a. $OTHER/=dm/LO

No economic team may borrow from another at an interest rate above 12.7 percent.

b. $CVPT/SCx pr MSx/E

No more than 15 population units from either class may be assigned to work at a single school or municipal service location.

c. $FSA

The HighwayDepartment may not request aid for more than 30 road segments per round and the Planning and Zoning Department may not submit more than three requests for aid in a round. The EDIT program will consider no more than five (5) FSA requests by the Highway Departments from all jurisdictions. It will process the first five received and disregard all others.

d. No input of more than 10 digits.

e. $PU

$262,143,000 is the largest possible price and no more than 100% of parcel may be purchased.

f. $BUILD

$671,080,000 is the largest possible price. (Prices offered and charged at employment locations must be between 50% to 150% of normal.)

g. $TIME

Up to 100 units may be allocated in each classification but not more than 100 total units may be allocated.

h. $VALUE*

The player input check does not permit more than $100 per unit. The director limit is $500.

i. $CASH

$3,435,800,000 is the largest possible amount of an appropriation or cash transfer.

j. $TAXES*

The input check permits no more than a 9.9% (99 units) tax rate. The limit on the director is 1000 mils (100.9%).

k. $ASMNT

Special assessment $1,196,100,000.

l. $BYCT

No more than a total of 44 boycotts are possible at a given time by a decision-maker, therefore, this is the upper limit on the number that can be input for a given round.

m. $RØUT

Route numbers 1 to 511 may be used. No other numbers are accepted.

n. No negative numbers.

The Edit (input processing) program puts practical constraints on the following input. (See page 102)

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*See Director's Summary Input Explanation Form in Appendix C for clarification of column values.

o. *$CVPT/=edm/P (prices)
R (rents)
S (setting wage levels)

Any input greater than 150% or less than 50% of the typical price, rent, or salary will be rejected.

p. *$OTHER/=MSx or SCx/S

Salaries to Municipal Services and School Department employees may not be less than 50% or greater than 150% of typical salaries.

q. $OTHER/=UT(1, 2, or 3)/P

Utility prices must be in the range of $5,000 to $15,000.

2. File Maximums

a. Number of economic teams (loaded value) = 26

b. Number of social teams (loaded value) = 26

c. Number of schools = 63

d. Number of municipal services = 127

e. Product of the number of PG's or PS's (including the outside as one) and resident class by parcel = 8400

f. Customers per PG or PS = 470

g. Number of loans by an economic team = 14

h. Number of bonds by a government department = 22

i. Maximum team cash = $30 billion

j. Maximum dollar number in any government field = 99 million.

3. How the Director Can Override Certain Input Maximums and/or Minimums

In order to experiment with several innovative economic, social or government programs such as cooperative commercial establishments, the

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*See Director's Summary Input Explanation Form in Appendix C for clarification of column values.

director may desire to override programmed input checks. This option exists for pricing (including rents), setting wage rates, setting wage rates, setting tax rates (above 9.9%), and setting the dollar value of time. Note that negative numbers may never be input, although zero ("0") is possible.

To illustrate the use of this option the general format of the input will be provided. All capital letters mean that those letters are mandatory for the decision to go through; all commas, dollar signs, equals signs, and slashes are in their proper places; lower case letters show where the variable values are to be input*, the additional values and characters which the director must input are denoted by the box around them.

a. For salaries to MS and SC Department employees:

$OTHER/=MS1, etc/S, amount [O, A]

b. For utility prices out of the $5,000 to $15,000 range:

$OTHER/=UT1 (or UT2 or UT3)/P, amount [,1]

c. For price, rent and salary changes for economic decision-makers:

$CVPT/=edm/P, location, amount [O, O, A]

R, location, amount [O, O, A]

S, location, amount, amount, amount [,A]

d. For taxes above 9.9%:

$TAXES/=CH1 (or CH2 or CH3)/type, amount [,1]

e. For setting dollar value of time above 100:

$VALUE/=sdm/H (or M or L), amount [,1]

f. In order to guarantee 100% probability on a land purchase from the outside system.

$PU/=dm/location, amount ($), OU percent [,1]

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*See Director's Summary input Explanation Form in Appendix C for clarification of column values.

# APPENDIX F

## LIST OF OUTPUT SECTIONS

APPENDIX F: List of Output Sections

(Items marked with asterisk do not appear until after round 1)

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 1. | @XQT EDIT* | Shows acceptance or rejection of each input decision. |
| 2. | HOUSING DISSATISFACTION FOR PL* | Histogram of number of PL's by housing by housing dissatisfaction level. |
| 3. | HOUSING DISSATISFACTION FOR PM* | Histogram of number of PM's by housing dissatisfaction level. |
| 4. | HOUSING DISSATISFACTION FOR PH* | Histogram of number of PH's by housing dissatisfaction level . |
| 5. | INITIAL POPULATION* | Pl by class and jurisdiction before migration and number of Pl's displaced by demolition of housing. |
| 6. | PERSONAL DISSATISFACTION FOR PL* | Histogram of number of PL's by personal dissatisfaction level. |
| 7. | PERSONAL DISSATISFACTION | Histogram of number of PM's by personal dissatisfaction level |
| 8. | PERSONAL DISSATISFACTION FOR PH* | Histogram of number of PH's by personal dissatisfaction level. |
| 9. | MIGRATION STATISTICS* | In-migration, out-migration, internal migration and natural population growth by jurisdiction and class. |
| 20. | ASSESSMENT CONSTANTS | Design parameters that are not changed. |
| 11. | ASSESSMENT FACTORS | Assessment rates for land and developments by type that are set by the assessment department by jurisdiction. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 13. | DEVELOPMENT ASSESSMENT AMOUNT MAP | Map of total private real property assessments in $100,000's |
| 14. | TOTAL ASSESSMENT AMOUNT | Map of total private real property assessment in $100,000's |
| 15. | PARCELS UP FOR AUCTION | Tabular list of parcels for sale and their asking prices. |
| 16. | AUCTION ASKING PRICE | Map of parcels for sale and their asking prices in $1,000's |
| 17. | MARKET VALUE OF PRIVATELY OWNED LAND FOR 100% OF PARCEL. | Map of market value of parcels assuming that the full parcel were privately owned in $100,000's. |
| 18. | DEVELOPMENT MARKET VALUE MAP | Map of actual market values of developments in $100,000's. |
| 19. | TOTAL MARKET VALUE OF PRIVATELY OWNED LAND AND DEVELOPMENTS | Map of combined market value of private land and developments in $100,000's. |
| 20. | ECONOMIC STATUS MAP | Map of private land ownership and development that also shows the zoning, utility level, percent of parcel undeveloped, and the road network. |
| 21. | GOVERNMENT STATUS MAP | Map showing government buildings (schools, municipal services, utility plants, and terminals), parkland and road. |
| 22. | SOCIAL DECISION-MAKERS | Map showing by residential parcel the social teams that control PH, PM and PL decisions. |
| 23. | PREEMPTED LAND AND PUBLIC INSTITUTIONAL MAP | Map showing the percent of each parcel that cannot be developed because of topographical constraints and the percent which is in public institutional use. |
| 24. | DEMOGRAPHIC MAP | Map showing the population (in 100's) percent occupancy, and quality index (QI) for all residential parcels, and the value ratio (VR) for all private non-residential developments (QI and VR figures show depreciated values before maintenance). |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 25. | PART-TIME WORK ALLOCATION FOR HIGH INCOME CLASS | Tabular list of residence location of part-time workers, their employers, the number of part-time units, and the yearly salary rate. |
| 26. | PART-TIME WORK ALLOCATION | Tabular list of residence location of part-time workers, their employers, the number of part-time time units, and the yearly salary rate. |
| 27. | PART-TIME WORK ALLOCATION FOR LOW-INCOME CLASS | Tabular list of residence location of part-time workers, their employers, the number of part-time time units, and the yearly salary rate. |
| 28. | EMPLOYMENT SELECTION INFORMATION FOR LOW-INCOME CLASS | Tabular output showing the place of residence of all Pl's, their employers, the number of not employed and employed by each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the route used to travel to work whether by auto or public transit. |
| 29. | EMPLOYMENT SELECTION INFORMATION FOR MIDDLE INCOME CLASS | Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the route used to travel to work whether by auto or public transit. |
| 30. | EMPLOYMENT SELECTION INFORMATION FOR HIGH-INCOME CLASS | Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the route to travel to work whether by auto or public transit. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 31. | EMPLOYMENT SUMMARY | Information by class and total for the number of Pl's employed at their design level or at lower levels, the number unemployed, the total number of Pl's, the part-time units worked, and the number of jobs full time that were not filled by the local labor force. |
| 32. | SCHOOL MAP | Map showing the location of schools, school boundaries, and the number of students attending public schools and attending private schools. |
| 33. | PERSONAL GOODS ALLOCATION SUMMARY | Tabular output showing the identification number assigned to each PG establishment, its location, owner, level, effective capacity, actual capacity used, price, and gross sales. For each customer it shows the store to which it is assigned, the customer location and type or class, the customer's owner, the consumption units (including those for maintenance and recreation), transportation costs (shadow costs in the case of (residences) the purchase cost (total cost in the case of residences), and total cost. |
| 34. | PERSONAL GOODS ALLOCATION MAP | Map showing the location of all PG's and the number of the PG to which each PH customer was assigned. |
| 35. | PERSONAL GOODS ALLOCATION MAP FOR MIDDLE-CLASS | Map showing the location of all PG's and the number of the PG to which each PM customer was assigned. |
| 36. | PERSONAL GOODS ALLOCATION MAP FOR LOW-CLASS | Map showing the location of all PG's and the number of the PG to which each PL customer was assigned. |
| 37. | PERSONAL GOODS ALLOCATION MAP FOR RESIDENCES | Map showing the location of all PG's and the number of the PG to which each residence was assigned for purposes of maintenance purchases. |
| 38. | PERSONAL SERVICES ALLOCATION SUMMARY | Tabular output that is identical in format to that for PG described under #33. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 39. | PERSONAL SERVICES ALLOCATION MAP FOR HIGH-CLASS | Map showing the location of all PG's and the number of the PG to which each PH customer was assigned. |
| 40. | PERSONAL SERVICES ALLOCATION MAP FOR MIDDLE-CLASS | Map showing the location of all PG's and the number of the PG to which each PM customer was assigned. |
| 41. | PERSONAL SERVICES ALLOCATION MAP FOR LOW-CLASS | Map showing the location of all PG's and the number of the PG wo which each PL customer was assigned. |
| 42. | PERSONAL SERVICES ALLOCATION MAP FOR RESIDENCES | Map showing the location of all PG's and the number of the PG to which each residence was assigned for purposes of maintenance purchases. |
| 43. | BUSINESS GOODS ALLOCATION SUMMARY | Similar to that for #33 except that residences are not customers of BG. |
| 44. | BUSINESS GOODS GOVERNMENT CONTRACTS | Tabular list showing the identification number of each BG that has a government contract, the contracting department, the number of CU's purchased, and the cost paid by the department. |
| 45. | BUSINESS GOODS | Map showing location of all BG's and the number of the BG to which each private BG customer in the local system was assigned to shop. |
| 46. | BUSINESS SERVICES | Similar to that for #33 except that residences are not customers of BS. |
| 47. | BUSINESS SERVICES GOVERNMENT CONTRACTS | Tabular list showing the identification number of each BG that has a government contract, the contracting department, the number of CU's purchased, and the cost paid by the department. |
| 48. | BUSINESS SERVICES ALLOCATION MAP | Map showing location of all BG's and the number of the BG to which each private BG customer in the local system was assigned to shop. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 49. | TERMINAL CUSTOMERS | Tabular list of the location, business type (land use), and terminal requirements of each terminal user. Each terminal is assigned an identification number and its location and level are noted. |
| 50. | TERMINAL ALLOCATION | Map showing the number of the terminal to which each terminal user in the local system is assigned. |
| 51-a. | SOCIAL DECISION-MAKER OUTPUT | Tabular list of socio-economic characteristics of the local system population separated by social decision-makers, jurisdiction, income class, and parcel location. |
| 51-b. | BOYCOTT STATUS | List of outstanding boycotts for each social team. Information for each boycott includes type and class of boycott and economic owner and establishment boycotted. |
| 52. | ECONOMIC RESIDENCE OUTPUT | Tabular list of characteristics of local housing separated by economic team. |
| 53. | ECONOMIC BUSINESS OUTPUT | Tabular list of characteristics of local business separated by team and listed in order of LI, HI, NS, BG, BS, PS and Construction Industry contracts. |
| 54. | ECONOMIC NEW CONSTRUCTION | Tabular list showing location of that team's new construction, the type and the old and new level of activity, the location of the construction industry, the contracted price, rent to be charged (if residence) or salary offered (if employer), the quality index (if residence) or price per CU (if commercial), and the status of the construction. |
| 55. | ECONOMIC BOYCOTT STATUS | Tabular list showing the team boycotting the income class (if a social boycott), or land use (if an economic boycott), and the function (work or shop) being boycotted. Also shown are the location, land use, and team being boycotted. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 56. | ECONOMIC LAND SUMMARY | Tabular list of the location of parcels owned by a team, their assessed value, percent that is undeveloped and private, the taxes on undeveloped land, the percent publicly developed and undeveloped, the percent undevelopable because of topographic constraints, the utility capacity available and used. |
| 57. | ECONOMIC LOAN STATEMENT | Tabular list showing borrower, lender, interest rate, years remaining on the loan, the original principal, and the annual payment. |
| 58. | ECONOMIC FINANCIAL SUMMARY | A cash flow statement showing expenditures and income, a portfolio of conservative and speculative stocks, and a balance sheet of assets and liabilities. |
| 59. | HIGHWAY DEPARTMENT REPORT | A financial report showing capital and current expenditures and revenues, outstanding bonds, a summary of maintenance levels and expenditures by road type, a summary of road conditions, a terminal status report, a list of undeveloped land, and a status report on available federal-state aid. |
| 60. | HIGHWAY DEPARTMENT CONSTRUCTION TABLE | Tabular list showing the construction firm, the location of the road being built, the status, the old and new level, the contracted price, and the dollar amount of federal-state used. |
| 61. | HIGHWAY MAP | An eight page map that shows the private land use on each parcel, the type of each road, the level of each terminal and the value ratio and peak-hour congestion along each road segment. |
| 62. | BUS COMPANY REPORT | A financial report showing capital and current revenues and expenditures outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers by each segment of each route. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 63. | PARTIAL TRANSPORTATION MAP (2 copies) | Map showing the road and rapid rail network. |
| 64. | FULL TRANSPORTATION NETWORK MAP (2 copies) | Map showing all roads, rail stations, and bus lines. |
| 65. | LIST OF RAIL TRACK SEGMENTS AND STATIONS | List of track segments (lengths of track between two intersections) and rail stations. |
| 66. | RAIL COMPANY REPORT | A financial report showing capital and current revenues and expenditures outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers by each segment of each route. |
| 67. | RAPID TRANSIT COMPANY CONSTRUCTION TABLE | Tabular list showing location of construction industry, tract locations, status of the construction, and the contracted price. |
| 68. | SCHOOL DEPARTMENT REPORT | Tabular data on school unit location, level, maintenance level, value ratio, students attending, teachers, student-teacher ratio, and use index. Also data on undeveloped land, BG and BS contracts and cost of purchases, adult education summary, and several total school statistics. |
| 69. | SCHOOL DEPARTMENT CONSTRUCTION TABLE | Tabular list showing the location of the construction firm, the school building location, the status of construction, the old and new level of the school, the contracted price, the amount of federal-state aid used, the maintenance level for the school, and the number of PM's and PH's assigned to work at the School. |
| 70. | SCHOOL FINANCES | List of capital and current revenues and expenditures, outstanding bonds, and available federal-state aid by school site location. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 71. | MUNICIPAL SERVICES MAP | Map showing the location of municipal services and the identification number of the MS serving each parcel. |
| 72. | MUNICIPAL SERVICES DEPARTMENT REPORT | Tabular list of MS locations, maintenance level, value ratio, effective capacity, loading (units of capacity used), number PL and PM's working, and the MS use index. Also shown are the salary levels, contracts to purchase BG and BS, the location of undeveloped land, and outstanding bonds. |
| 73. | MUNICIPAL SERVICES DEPARTMENT CONSTRUCTION TABLE | Tabular list showing the location of the construction firm, the MS location, the status of construction, the old and new level of the MS, the contracted price, the maintenance level, and the number of PLs and PM's assigned to work at the MS. |
| 74. | MUNICIPAL SERVICES FINANCES | List of capital and current revenues and expenditures. |
| 75. | UTILITY MAP | Map showing utiltiy plant locations, the number of the utility plant serving each parcel that has utility service, and the level of utility service on each of those parcels. |
| 76. | UTILITY DEPARTMENT REPORT | Tabular list of utility plants, their location, level, units installed from each plant, units served, total operating costs per unit, and income derived from charges. Also listed is the charge per unit to customers undeveloped land, and outstanding bonds. |
| 77. | UTILITY DEPARTMENT CONSTRUCTION TABLE | Tabular list showing the location of the construction firm, the site of the utility plant, the status of the construction, and the contracted price. |
| 78. | UTILITY DEPARTMENT FINANCES | List of capital and current revenues and expenditures. |

| | NAME OF OUTPUT | FUNCTION |
|---|---|---|
| 79. | PARKLAND MAP | Map showing the amount of parkland available per parcel and a usage index for each park. |
| 80. | ZONING MAP | Map showing the zoning classification of each zoned parcel and a key showing the definition of each zoning classification. |
| 81. | PLANNING AND ZONING DEPARTMENT REPORT | Shows total jurisdiction population, total amount of parkland, outstanding bonds, and capital revenue and expenses. |
| 82. | BUDGET CHAIRMAN AND COUNCIL OUTPUT | Shows the total jurisdiction population, the welfare payment per unemployed worker, and the financial summaries for municipal services, schools, highways, planning and zoning, utilities, and the chairman's account. Also included are outstanding bonds. |
| 83. | FINANCIAL SUMMARY | A tabular list showing by department the previous cash balance, capital revenues, current revenues, capital expenditures, current expenditures, and new cash balance. |
| 84. | TAX SUMMARY | Tabular list showing by the eight possible tax bases, the dollar amount of the tax base, the tax rate, and the revenue generated. |
| 85. | DEMOGRAPHIC AND ECONOMIC STATISTICS | Tabular list by jurisdiction and for the total system of population and its characteristics, land usage, housing, employment, earnings, income from the national economy, outflows to the national system, and national business cycle effects. |

# APPENDIX G

## ELABORATION OF SOME PLAYER AND COMPUTER PROCESSES

APPENDIX G. Elaboration of Some Player and Computer Processes

## I. INTRODUCTION

This Appendix is intended to provide the Director with some detailed aspects of CITY MODEL which are not explained fully in the Player's Manual. Frequently, players who know how the model works generally desire to understand it more deeply. The explanations will cover the following topics:

a. The Full-Time Employment Process -- the actual method of assigning workers to jobs.

b. The Part-Time Work Allocation Process -- an explanation of the manner in which population units are assigned extra work. Listing the factors involved permits inferences to be drawn for the extra work time allocation of social decision-makers.

c. The Commercial Process -- criteria used in the assignment of buyers to sellers.

d. The Effects of Time Allocation in Education -- the effects of time in adult education on the educational level of population units.

e. Bus and Rail Company Output -- detail on the meaning of several portions of Bus and Rail output including Transportation Network Maps.

f. The $REDIST Input -- and explanation of the manner in which redistricting decisions are processed; sources of input errors are highlighted.

g. Government Contracts with Business Services and Business Goods Establishments -- an explanation and illustration of how the player should input new contracts, replacement contracts, and elimination of contracts.

h. The Effects of the Outside System -- details on the business cycle (including determination of the interest rate on loans from the Outside) and on Federal-State aid and taxes; the role of the Outside in the Migration Process; the method of determining the value of outside-owned land parcels; the role of the outside in construction; the relation of outside suppliers of goods and services to the local system.

i. Business Profitability -- the assumptions underlining some of the parameters used in the economic sector to assure a reasonable rate of return for businesses (under "normal" conditions).

j. The Migration Process -- details on the calculation of personal and housing dissatisfactions, selection of in-migrants and out-migrants, and placement of Pl's into housing.

## II. THE FULL-TIME EMPLOYMENT PROCESS

Each income class is considered separately, highest first. There are two major sections to the employment process: choosing a job and selecting the best mode of transportation to work. The former section will be discussed in detail first.

This operation occurs during the processing of each round's decisions. In this process, all jobs are considered "open" and are examined each round for possible new employment by qualified workers. But, for reasons explained below, workers do not always change jobs each round.

Another overall consideration is that in the first sort, in which workers of all classes "decide" to retain their present job or change to a possible new one, and in all subsequent matching the process is performed in order of class, high income class first. This process is always top down, meaning that in a job shortage, high income workers can take middle income jobs but never the reverse. Where workers of the same class are competing for the same job opening, the ones with the higher education level win.

There are occasions when some high income workers will be unemployed while all middle income workers will have jobs. This situation occurs when a high income worker cannot afford to either remain in his present job or take a new one (because his costs are too high, or because both job openings do not pay enough).

Note here that the emphasis is on what workers will or can afford to accept and not so much on what is available. This relationship is conditioned by several things, among them the supply and demand curve, what economic decision-makers decide to pay, how the government sector is providing transportation and general social sector dissatisfaction.

In order to choose a job, a P1's estimated transportation cost to each job (using last round conditions) must be calculated. The best route to each employment location is calculated from each parcel containing high-income workers. Of course, the best route is the same for all workers of a class on a parcel. The "best" route is the cheapest influence by the usage of the transportation network last round and the dollar value of time traveling. Although the time cost is not paid by a worker in dollars, it is a significant factor in the selection of routes and modes of travel.

Generally, the transportation cost (weighted by time and money) is subtracted from the salary offered by each employment location, yielding the direct net income a worker would receive there. To reflect job stability the direct net income from a possible new job must exceed that of the last round's job by at least 10 percent before a worker will "consider" changing. This bias toward stability is accomplished by artificially increasing the new round's wage of the present job by 10 percent during the round's employment allocation process. Thus, the highest direct net income of a possible new job is compared with the artificially high wage of the present job during each round's employment allocation. Workers take the job with the highest apparent income, either the inflated wage of the present job or the highest direct net income of a possible new job.

In three situations -- where a business has been downgraded, where a construction industry has less need for labor this round, or in the case of public employment, where there was a cutback in requested employees -- the most educated employees are hired and the rest are considered still unemployed, if more employees are available for their previous jobs at a particular location than there are jobs available.

All high-income Pl's on a parcel have the same educational level. The best educated groups of Pl's try for jobs with the greatest direct net income. If there are not enough job openings for all high-income living on the parcel at their best employment location, as many as possible are assigned jobs there. The rest look for their next best job, again comparing the artificially inflated income of their present job with the direct income of a possible job (the repeat of the process mentioned above). The process is repeated until all of the workers of that class on the parcel have jobs, or until both the artificial and direct incomes are negative. Then the next best educated group is considered for jobs. If workers living on two or more parcels have the same education level, the order of consideration is random. The least educated group is considered for jobs last.

When all workers of the class have tried for jobs, the part-time employment process occurs. (See Section III of this Appendix.)

The entire employment process runs each time for the next lower class, plus those of the previous class still without full-time jobs who are put at the top of the list because of their higher educational levels.

When employment has been run for all classes, the new traffic congestion and actual transportation to work costs and modal choices are calculated. In other words, the origins and destinations of work trips are now known and the routing and modal choice must now be determined. The new and old congestions are compared. If the new congestion exceeds the old on any road segment or bus or rail route by more than the percent population increase plus 10%, the best route to work is recalculated for everyone, based on the new congestion. Jobs are not sought anew -- only routes to work. Of course, if a road or route is not overcrowded, the percentage increase in congestion is ignored as a factor in determining whether to recompute routes. The routing and congestion comparison process is repeated up to three times or until the change in congestion does not exceed the percentages given above. The final routes to work and usage by mode become the congestion considered in the next round's employment process.

In the case of government employment, no specific place of employment (i.e., no parcel) is designated. Rather, fixed transportation costs and travel times are used for each population class in round one. The dollar and time cost to travel to government full-time employment (SC, MS, BUS, RAIL) in subsequent rounds is the average for all other working population units. A single average time cost is calculated for all three population classes, whereas a separate average dollar cost is calculated for each class.

## III. THE PART-TIME WORK ALLOCATION PROCESS

Social decision-makers realize that their population units seldom receive all the extra work for which time was allocated. As with the full-time employment allocation process, the Pl's educational level is the most important factor in the assignment of part-time work units to extra work time allocation.

The supply of part-time work units, eighty of which are equivalent to one full-time job, is primarily determined by the levels of business activity in the system. The following table gives the fixed supply ratios of part-time units for each class of Pl per level of business activity.

| LAND USE | LOW | MIDDLE | HIGH |
|---|---|---|---|
| FL | 240 | 80 | 0 |
| SG | 160 | 160 | 80 |
| MP | 320 | 160 | 80 |
| MF | 160 | 160 | 80 |
| NL | 160 | 80 | 80 |
| EL | 80 | 80 | 80 |
| TE | 80 | 80 | 80 |
| FO | 80 | 80 | 0 |
| TA | 240 | 0 | 0 |
| PA | 160 | 0 | 80 |
| CR | 80 | 80 | 80 |
| NS | 0 | 0 | 80 |
| BG | 0 | 0 | 80 |
| BS | 0 | 0 | 80 |
| PG | 160 | 80 | 0 |
| PS | 160 | 80 | 0 |

Variable supply of part-time work units (jobs) is provided in the two ways listed below.

CI - For each CI location, the supply varies from 0 - 100 units per class (each class is requested in equal numbers) according to the amount of construction labor units required in a particular round.*

SC - By jurisdiction the school department provides public adult education according to the number of middle and high income part-time work units it hires. This specification obviously can fluctuate considerably round-to-round.

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*The total labor units required by a CI is divided by 50 to determine the full-time Pl's required in each of the three classes. The remainder is multiplied by two to derive the number of part-time labor units.

Two lists -- one supply of and the other demand for part-time work units -- are created for each population class. The suppliers of part-time work units are ordered by the salary offered (proportional to full-time wage offered) with the highest salary placed first. Each entry on this list contains a location, a full-time salary per worker, and an amount of part-time work units available.

Each entry in the demand for units list is comprised of a residence group for which allowed time for extra work as defined by a parcel location, an average education level, and an average time allocation for extra work.* The number of Pl's in each group is the final item of information. This list is ordered on the basis of average education level with the highest levels first.

For each complete pass through the list of residence groups, the part-time work allocation process attempts to assign by class ten units of extra work to each population unit which has an unfilled extra work allocation. The process continues until either all requests (unfilled allocations) are filled or until the supply of part-time work units is exhausted.

First, the residence group at the top of the list (i.e., the one with the highest education level of those groups who have not yet been assigned work in that particular pass) is examined. The number of Pl's is multiplied either by ten or by a figure less than ten (if there are less than ten unfilled extra work time allocation units remaining) in order to obtain the group's request for part-time work units. For example, assume in the first pass that 6PH's at 10026 have the highest education level and that the social decision-maker allocated 25 time units to extra work for each PH. The total demand for units of this group in the first pass is sixty (60). These population units will have their employment request of sixty part-time units met before any other high-income population units are considered.

Once the request is determined, the job supply list is examined. For each potential work location, a shadow automobile transportation cost per worker is calculated. This value is subtracted from the salary per worker to obtain a net income per worker which is used to determine the best job. Units from this best job are assigned to the residence group up to the amount of their request. If that particular job has an insufficient supply of part-time units available, the remainder of the request must be met by the second best job, and so on.

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*Pl's of the same class who live on the same parcel. Each Pl so grouped has averaged, and thus identical, characteristics such as education level and time allocated for extra work.

After the job units are assigned to the particular residence group, their per P1 unfilled extra work time allocation units are decremented by ten (or the figure less than ten) and they are placed at the bottom of the residence group list. Of course, if the residence then has no more units to be filled, they are dropped from further consideration.

Subsequently, a different residence group appears at the top of the list and the assignment process proceeds in the identical fashion. This continues until either of the two mentioned termination criteria are reached. High-income population units may not be assigned middle or low income part-time jobs, nor may middle take low or high, and so forth. With an income class, the only case in which a P1 would receive a part-time job before another P1 with a higher education level is the case in which the shadow transportation cost exceeded the remuneration expected from the particular job.

The implications for a social decision-maker in a play are fairly obvious. As much time as is feasible should be allocated to education in order to raise a P1's relative standing in terms of education level. Moreover, in order to boost the income of less educated P1's who are already worse off due to the effect of education level in full-time employment, a team should allocate no time to extra work for the highest educated members of the particular income class. This will enable the less fortunate P1's to be higher in the list of residence groups. Finally, note that the allocation of large amounts of time to extra work has no effect on the assignment of part-time units to population units.

# IV. THE COMMERCIAL ALLOCATION PROCESS

## Overview

Each round the commercial allocation process assigns buyers to sellers, each buyer being assigned to shop at the commercial establishment at which the buyer can obtain his required goods or services most cheaply. The cost which a buyer perceives at each of his options for a shopping location is a function of the transportation cost to get to the location, the crowding at that location, the seller's price, and the buyer's preference for shopping at the establishment where he shopped the previous round. Every buyer evaluates all possible shopping locations each round.

The allocation process is iterative. Each buyer selects the shopping location which is cheapest for him, and after all buyers have selected shopping locations, all reevaluate their selections in light of the crowding created by the previous selection process. The entire selection process is repeated until between two successive evaluations no buyers decide to change their selections from the previous iteration. Every buyer evaluates all possible shopping locations each iteration.

There are several reasons for the iterative procedure. No business has an infinite capacity in terms of the number of customers whom it can serve or the number of goods or services which it can provide. Thus, the usage of an establishment by other shoppers is a factor in a buyer's decision as to whether to shop there. Crowding, or overusage, at a commercial establishment can be viewed as a cost to the buyer in terms of annoyance, poor or inadequate service, or length of time waiting for an appointment.

The allocation process could assign buyers to sellers one at a time, each buyer considering the usage created by all buyers processed before him. However, those buyers selected for assignment first would have the advantage fo seeing unused sellers, and since crowding is only one factor in the determination of "cheapest", those buyers would tend to purchase goods and services at the least dollar cost to them. Buyers selected later for processing would tend to find the cheapest sellers in dollar cost too crowded and therefore too expensive. Such a procedure of assignment introduces non-systemic biases in the selections of shopping locations. The bias would be a result of the order in which buyers are selected for assignment, and not a result of local system conditions.

The actual allocation process employed by the model assigns all buyers to sellers simultaneously. Each commercial establishment's usage as seen by a prospective customer is affected by the establishment's usage after the previous iteration, or in the case of the first iteration in a round, affected by the establishment's usage after the final iteration in the previous round. The perceived usage is only affected by the previous usage. If the previous usage were always the perceived usage, the selections of shopping locations would tend to flip-flop from one iteration to the next. Since prices at commercial establishments and cheapest transportation costs from buyers to sellers do not change between iterations, only usage would cause a location to appear more desirable in one iteration than in another iteration. Buyers would tend to flock to one location on one iteration and, in the next iteration, see that location as overcrowded and all flock to another location. On the following iteration, the first establishment would appear underused and the buyers would all return. So, the actual usage of a commercial establishment is adjusted in the allocation process to a "base perceived" usage. With each iteration of commercial allocation in a round, the effect of the actual usage of a commercial establishment tends to decrease relative to the base perceived usage establishment.

The shadow cost for a buyer to shop at a commercial establishment is a function of: 1) its base perceived usage; 2) the added usage which would result if the buyer were to shop there but did not shop there on the previous iteration; 3) the establishment's effective capacity; 4) its price; 5) the buyer's least transportation cost to travel to the location; and 6) the buyer's bias toward shopping where he shopped last round. The result of this function is the shadow cost to a buyer to shop at each commercial establishment. Each buyer selects the commercial establishment with the least shadow cost to him. If the least shadow cost is the Outside System, the buyer does not use a local establishment.*

A buyer's actual expenditure is the real transportation cost and actual price charged at the commercial establishment which he selects on the final iteration.

---

*Note: The Outside System as a seller of goods and services has only a price. It has no perceived usage, an infinite capacity, and no transportation cost. A buyer who shops Outside does not have a bias toward shopping there in the following round.

The commercial allocation process can be viewed as a series of steps:

1. Calculate the effective capacity of each commercial establishment.

2. Calculate the least transportation cost from each buyer to each seller.

3. Calculate the base perceived usage of each commercial establishment. (This is the only reiterative step for the sellers. The remaining calculations are performed for each buyer as he considers each seller.)

4. From each buyer's point-of-view, adjust the base perceived usage of the commercial establishment to reflect its usage if he were to shop there but did not shop there on the previous iteration.

5. Use the result of step 4 as the numerator in a fraction for which the result of step 1 is the denominator. This is the shadow ratio of perceived usage to capacity.

6. Apply the shadow ratio to the function shown on the graph in Figure 1. Determine the y-coordinate which corresponds to the appropriate ratio.

7. Sum the price per unit charged at the commercial establishment and the least cost per unit purchased for the buyer to travel to the commercial establishment.

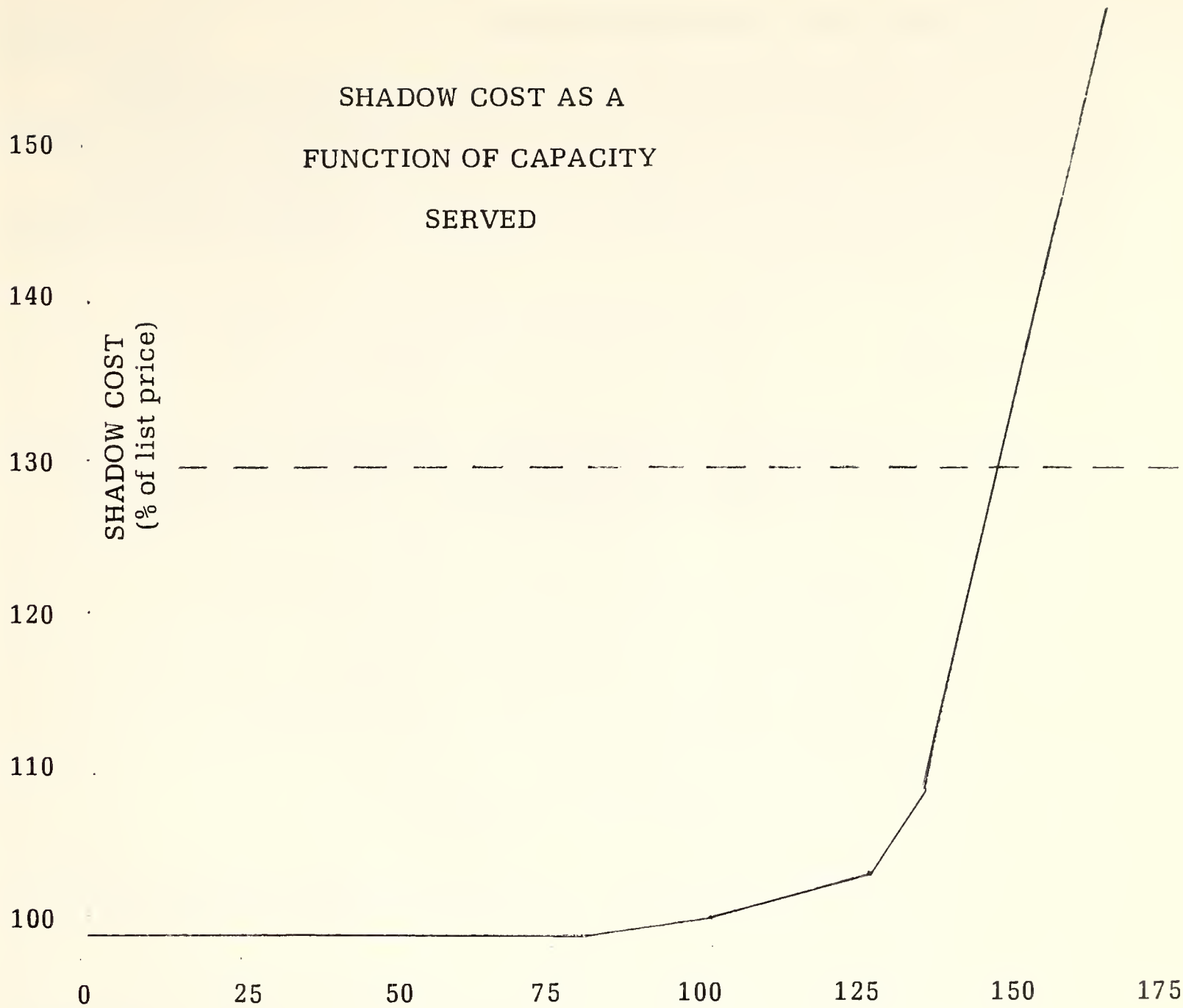
8. Multiply the result of step 6 by the result of step 7.

9. If the buyer shopped at the commercial establishment last round, multiply the result of step 8 by .9.

10. The result of steps 8 and 9 is the shadow cost for the buyer to shop at the commercial establishment. (Repeat steps 4-10 for each seller which the buyer can consider.)

11. Assign the buyer to the commercial establishment which has the least shadow cost for him. (Repeat steps 4-11 for each buyer.

12. Determine whether another iteration is necessary. If so, repeat steps 3-11. If not, all assignments are final for the round.


SHADOW COST AS A
FUNCTION OF CAPACITY
SERVED
SHADOW COST
(% of list price)
150
140
130
120
110
100
0
25
50
75
100
125
150
175
PERCENT OF CAPACITY

Detail on Parts of the Allocation Process

The commercial process is run first for buyers of PG and PS. PG and PS establishments are buyers of BG and BS, and their purchases are a function of their sales. Thus, customers are allocated to PG and PS before any customers are allocated to BG and BS. The two allocation processes are identical except for the consideration in the BG-BS allocation of usage by government departments which have contracts consuming capacity at some commercial establishments.

Step 1. Calculate the effective capacity of each commercial establishment.

A business's effective capacity is a function of its level, its type of business, its value ratio, and the number of employees which it received through the employment process in relation to the number of employees which it requires in order to operate at its level. The Outside System, one seller of goods and services, has an infinite capacity.

E = Effective capacity of a commercial establishment

PR = Total number of Pl's required by the establishment

PH = Total number of pl's hired by the establishment in the employment process

VR = The establishment's value ratio

C = Design capacity of the establishment (the capacity of a level one of the business type times the establishment's level)

E = PH/PR X VR/100 X C

Step 2. Calculate the least transportation cost from each buyer to each seller.

The transportation network used for commercial travel includes the roads only. Bus and rail are not modal options. The roads are viewed as unused by all travellers; road congestion is not a factor in the selection of least transportation cost. The selection process itself uses the Moore algorithm to calculate least transportation cost from each buyer to each seller.

Step 3. Calculate the base perceived usage of each commercial establishment.

$V_{i+1}$ = The base perceived usage or a commercial establishment to be used in iteration i+1

$S_i$ = The actual usage of the commercial establishment in iteration i

K = A constant 20/21

N = The number of previous iterations in the round in which either:

1) the number of buyers who changed their shopping locations was greater than or equal to the number who changed shopping locations on the previous iteration, or

2) no buyers changed shopping locations but the difference between the actual usage (S) at a commercial establishment and the base perceived usage (V) was greater than 20 capacity units.

N is incremented if either of the two conditions listed above obtains within an iteration, and the new value of N is used in calculating the next iteration's V.

$$V_{i+1} = S_{i+1} * K^{(N)} + (1.000 - K^{(N)}) * V_i$$

Step 12. Determine whether another iteration is necessary. If after step 3 both 1) no buyer changed his shopping location, and 2) the base usage of each commercial establishment is within 20 capacity units of its actual usage, then the allocation process is finished and the shopping assignments are final for the round. If either of the two criteria for finality is not met, steps 3-11 are repeated, using the results of this iteration.

## V. THE EFFECTS OF TIME ALLOCATION IN EDUCATION

The accompanying figure shows the relationship that exists between old education level, time spent in adult education (pay plus free), and new education level. The row headings are the old educational levels, the column headings are the time units actually spent in adult education (equal to or less than the time allocated to adult education), and the numbers in the table are the new educational levels.

Assume that a low income population unit had an old educational level of 20 and spent 40 time units in adult education. This would raise the educational level for that unit to 23 for the next round. Note that for that population unit, any time spent in adult education above 23 units would raise the educational level and any time spent less than 18 would lower the educational level. Also, note that when a PL reaches its highest educational level of 39, it must continue to spend at least 30 units of time in adult education to maintain that educational level. Similarly, PM's must spend at least 24 time units to maintain their highest level of 69, and PH's must spend at least 32 time units to maintain their highest level of 99.

Educational levels are very important in the employment process; therefore, if a social decision-maker is satisfied with the educational levels of his Pl's, he should realize how much time must be spent in adult education to simply maintain the present levels. The following educational levels require the indicated amounts of time spent in adult education to just maintain the educational level.

| Educational Level | Time Units |
|---|---|
| 0 | 0 |
| 10 | 12 |
| 20 | 18 |
| 30 | 24 |
| 40 | 0 |
| 50 | 12 |
| 60 | 18 |
| 70 | 0 |
| 80 | 16 |
| 90 | 24 |

New Educational Level as a Function of Old Educational Level and the Amount of Time Actually Spent in Adult Education

| OLD EDUCATIONAL LEVEL | TIME UNITS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL | 0 | 6 | 8 | 10 | 12 | 16 | 18 | 20 | 24 | 30 | 32 | 36 | 40 | 42 | 48 | 50 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 | 6 | 7 | 7 |
| 10 | 9 | 9 | 9 | 9 | 10 | 10 | 11 | 11 | 12 | 13 | 13 | 14 | 14 | 15 | 16 | 16 |
| PL 20 | 18 | 18 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 22 | 22 | 23 | 23 | 24 | 25 | 25 |
| 30 | 27 | 27 | 27 | 28 | 28 | 29 | 29 | 30 | 31 | 31 | 32 | 32 | 32 | 33 | 34 | 34 |
| 39 | 35 | 36 | 36 | 36 | 36 | 36 | 37 | 37 | 38 | 39 | 39* | 39* | 39* | 39* | 39* | 39* |
| 40 | 40 | 40 | 40 | 40 | 41 | 41 | 42 | 42 | 43 | 44 | 44 | 45 | 45 | 46 | 47 | 47 |
| PM 50 | 49 | 49 | 49 | 49 | 50 | 50 | 51 | 51 | 52 | 53 | 53 | 54 | 54 | 55 | 56 | 56 |
| 60 | 58 | 58 | 58 | 58 | 59 | 59 | 60 | 60 | 61 | 62 | 62 | 63 | 63 | 64 | 65 | 65 |
| 69 | 66 | 67 | 67 | 67 | 67 | 67 | 68 | 68 | 69 | 69* | 69* | 69* | 69* | 69* | 69* | 69* |
| 70 | 70 | 70 | 70 | 70 | 70 | 71 | 71 | 71 | 72 | 72 | 73 | 73 | 74 | 74 | 75 | 75 |
| PH 80 | 79 | 79 | 79 | 79 | 79 | 80 | 80 | 80 | 81 | 81 | 82 | 82 | 83 | 83 | 84 | 84 |
| 90 | 88 | 88 | 88 | 88 | 88 | 89 | 89 | 89 | 90 | 90 | 91 | 91 | 92 | 92 | 93 | 93 |
| 99 | 96 | 96 | 97 | 97 | 97 | 97 | 97 | 97 | 98 | 98 | 99 | 99 | 99* | 99* | 99* | 99* |

*Income class maximums cannot be exceeded.

NOTE: The column headings (time actually spent in adult education) are listed in such a way that all points at which the educational level changes are indicated. For example, for a P1 with an initial educational level of zero, an expenditure of 12 time units in adult education is required to raise the new educational level to one. The expenditure of from 13 to 17 time units by this P1 would still only raise the old educational level to one. An expenditure of 18 time units is required to raise the new educational level to two.

## VI. BUS AND RAIL COMPANY OUTPUT

This explanation is intended to supplement the output description given in the Players' Manual.

### a. Financial Report

1. Capital Expenditures - Vehicle Purchase: If units of equipment are sold, an amount equal to .50 X Average Value Ratio X number of units sold X $10,000 is credited as a negative figure under vehicle purchase.

2. Current Income - Fares: This figure is the sum of the yearly fares paid by each employee that uses the bus to travel to work (see Employment Detail). The fare charged by the company is for a single worker-trip; the yearly amount is calculated based on two trips per day, five days per week fifty weeks per year (i.e., single trip fare times 500). As the yearly fare per worker is automatically expressed in tens of dollars, the total fares printed out may be somewhat less than the number that would be derived by carrying more significant figures. (This is true only for the regular scale (P1 = 500 people); the figures for the small scale (P1 = 50 people) should be exact.)

### b. Employment

1. As the Bus and Rail Companies hire employees (PM's) in groups of 160 workers, it is in the companies' interest to keep the total combination of service level and route lengths such that "Personnel Required" is equal to or slightly below a multiple of 160. For example, if 328 personnel are required, three PM's would be requested and paid for although only slightly more than 2 PM's would be utilized. Personnel requirements can be calculated using route miles and level of service (see Players' Manual).

2. All government and quasi-public companies which hire employees (SC, MS, BUS, RAIL) have the same fixed transportation cost for a given class. This fixed cost is the average travel cost and time for non-government workers in each class. Dollar cost differs by class but time is the same and both are recalculated each round. If BUS and RAIL are not successful in hiring any workers, the systems will not carry any passengers.

c. Rolling Stock

1. Units Owned is the total number of equipment units owned by the company; purchase of sales of equipment are shown here.

2. Units in Use is equal to the units required up to a maximum of Units Owned; Units in Use is the number of equipment units which undergo depreciation.

3. Serviceable Units is Units Owned times the Average Value Ratio/100.

One of the considerations entering into the passenger capacity of a route is the "effective" number of units/mile operating on that route (employment and level of service are the other considerations). Each mile of level one route has a requirement of 40 equipment units for full capacity. The total requirement for the system is summed under Units Required. The actual number of units used is the lesser of Units in Use or Serviceable Units. For example, if the units required is 400 and there are only 200 serviceable units, then the passenger capacity is half of the desired capacity of the system.

d. Passengers

The number under Total Passengers includes transfers from one route to another which is done at no cost. Therefore, they are not all full paying passengers on that route. Passengers who transfer between modes pay costs for each mode. That is, a worker who drove to a bus station, took a bus to a rail station, and took the rail to his place of employment would pay an auto cost and separate fares to the Bus and Rail companies.

In order to economically carry passengers, Bus and Rail routes must take Pl's from where they live (or from where they can economically drive to where they work. Thus, it is important both that the routes have stops (or stations) in many residential locations (and in higher residential density locations) and that the routes provide access to a number of work locations. It would be very uneconomical to have a long winding route through low density residences terminating near only one or two employment locations. (Typical cost/mile and break-even fares are noted in the Master Tables.) As mentioned in the Players' Manual, the routes are directional and are specified to carry workers from residences to their employment location; if a route is specified A $\longrightarrow$ B $\longrightarrow$ C $\longrightarrow$ D, the route would not carry passengers from C to B. A new C $\longrightarrow$ B would have to be specified.

e. Routes

This portion of the output indicates by route where the bus or rail stops, how many passengers got off at that stop, how many got on, and how many passengers are riding between stops. This information indicates what portions of a route are underutilized and which are overcrowded and thus should affect decisions involving extending, deleting, or upgrading a particular route. The figure for Total Passengers under the transit summary is the sum of all passengers riding the given route, not their distribution; i.e., a route (level 1) may have 9000 total passengers, but yet be distributed in such a manner that no segment of the route is overcrowded. Data on which segments are overcrowded would come from the Routes output. If a route is highly overcrowded in one round, the computer will probably assign a much lower ridership the following round.

Additional information for each P1 on where they live, where they work, and mode, route and cost of transportation is given in the Employment Detail. The game Director may want to withhold the Routes portion of the output from the Bus and Rail Companies and charge them (Cash transfer to outside) a consultant's study fee for the information.

f. Transportation Network Maps (2 copies each of 2 maps)

It should be noted that the map which includes residences (R) and work locations (W) shows land use only. The map does not indicate either density or class of workers on a residential parcel or total number or class of jobs on an employment parcel. Business type can be obtained from the Economic Status Map, population is shown on the Demographic Map, and the class of P1's is shown on the residence output of the economic decision-makers.

On the page following the last Transportation Network Map there is a printout of the list of Rail track segments and Rail stations. This page should be given to the Rail company along with one copy of each type of the transportation network maps (the other set going to the Bus company). This is the only place where a complete list of track and station locations is printed.

## VII. THE $REDIST INPUT

The $REDIST input decision may be used by both the municipal services and school departments of each jurisdiction. The inputs may be ordered haphazardly within the list of inputs because they are not analyzed by the EDIT program until all inputs have been read.

After the end of the input decisions, EDIT sets up a dummy board in which ir compares the original districts with the specifications offered by any new inputs. Of course, this is done only for those departments and jurisdictions which have submitted redistricting decisions. Not only do the new inputs have to be consistent and meet the contiguity constraint, but also the new inputs in conjunction with the previous district allignment must meet all constraints.

New inputs overlay control and boundaries. That is, it is sufficient to include a parcel which was previously served by a different plant or school (for illustrative purposes, the plant at 9632) as being in a new district -- the district for 9632 does not have to be redefined.

Note player input mistakes which invalidate their whole set of redistricting decisions:

a) crossing a jurisdiction line

b) attempting to relist a parcel on which there is a plant

c) cutting off service which had previously existed to some distant parcels with a new plant

d) failing to meet contiguity with the inputs themselves

The players should be reminded that if any error is made in any one of their redistricting inputs, the entire set of redistricting for the department in a particular jurisdiction will be rejected.

## VIII. GOVERNMENT CONTRACTS WITH BG AND BS ESTABLISHMENT

The school and municipal service departments from each jurisdiction will nto purchase any of their business goods and services from local establishments unless they submit a contract input. This input offers flexibility in the amount of goods or services the department can acquire from different local BG's and BS's. For each local establishment (regardless of its jurisdiction) with which a department wishes to contract, it must specify the desired percentage of total purchases, the priority that the new contract is to have with respect to other current contracts, and the priority that the displaced contract (if any) will have. Priorities are pertinent in a situation in which the total specified percentage exceeds 100.

For example, assume that in year "t" the School Department in jurisdiction one wanted to purchase 50 percent of its goods from A's BG1 at 10044, 25 percent from B's BG2 at 9830, and 25 percent from G's BG1 at 9228. Prior to year "t" there were no contracts. Furthermore, the department wanted to give G's contract priority over B's contract, and B's contract priority over A's contract. The School Department decision-maker should submit the following input.

```
$CVPT/=SC1/C,9228,25,1,0,G
       /C,9830,25,2,0,B
       /C,10044,50,3,0,A
```

Assume that in the following year (t = 1) the department decided to replace the purchases of 25 percent of its needed goods from team B with purchases of 40% of its goods requirement from team E's BG1 at 9436. The new contract is specified as having the same priority. The input would be

```
$CVPT/=SC1/C,9436,40,2,2,E
```

This means that team E's BG replaces team B's BG on the contracts list, and now only 35 percent is purchased from team A because the sum of the percentage allocations exceeds 100.

Other cases and sample inputs follow:

Case 1. Round t - 1: MS1 has one contract for 100% with E's BS at 9632.

Round t: MS1 desires to contract for 50% with F's BS at 10030 at top (first) priority and purchase the other half of his needs at the original contractor.

Input: $CVPT/=MS1/C, 10030, 50, 1, 2, F

Case 2. In Round t = 1, MS1 chooses to eliminate both of these contracts.

Inputs: $CVPT/=MS1/C,10030,50,0,0,F

C,9362,100,0,0,E

## IX. THE EFFECTS OF THE OUTSIDE SYSTEM

Together, the game Director and the computer represent the Outside System. The major components of the Outside System are:

a. Business Cycle -- affects prices paid for basic industry output, the return on investments in stocks, and the interest rate on loans and bonds involving the Outside System.

b. Federal-State Aid -- affects the amount and type of aid that local government departments and economic teams may receive.

c. Federal-State Taxes -- affects the taxes that leave the local system.

d. Migration -- affects the movement of people (Pl's) into and from the local system.

e. Auction and Bids -- affects the chances of teams or departments acquiring land that is presently owned by Outside interests.

f. Construction Industry -- affects the price of construction and demolition of land uses by outside firms.

g. Suppliers of Goods and Services -- affects the price at which all goods and services may be purchased from the Outside.

The different components of the Outside System will be described in the order listed above. Director influences and relevant computer output will be noted.

### a. Business Cycle

Basic Industry Prices - The business cycle in the CITY MODEL Follows the pattern shown in Figure 1. Note that the variation in HI average prices is greater than that for LI which is, in turn, higher than that for NS. To calculate the price received per unit of output for any basic industry in the local system, multiply the normal price per unit for that type of basic industry times the business cycle index for that basic industry. For example, the price per unit of output for an HI in Round 2 would be $190,000 times 1.08 = $205,200.

Loan and Bond Interest Rates - The basic outside loan rate is also related to the national business cycle. The interest rate shown in Figure 1 is used as an average when the actual interest rate on each loan is calculated.

In order to determine the interest rate on a specific loan from the Outside, the computer generates a random number between 1 and 1024. Depending on what the random number is (see Table A, page 140), a percent is added to or subtracted from the average interest rate for the round, as shown in Figure 1.

FIGURE 1

BUSINESS CYCLE

| Edits Before Round: | Output For Round: | Outside Loan Mean Interest Rate (%)* | Basic Industry Ratio of Price Per Unit Output To Normal Price | | | Percent Return on Investments (Mean) | |
|---|---|---|---|---|---|---|---|
| | | | HI | LI | NS | Conservative | Speculative |
| 1 | 24 | 5.1 | 1.05 | 1.04 | 1.03 | 6.1 | 8.9 |
| 2 | 1 | 5.2 | 1.08 | 1.07 | 1.05 | 6.3 | 9.2 |
| 3 | 2 | 5.7 | 1.07 | 1.07 | 1.06 | 6.2 | 4.7 |
| 4 | 3 | 5.3 | 1.03 | 1.04 | 1.03 | 6.1 | 8.7 |
| 5 | 4 | 5.1 | .99 | 1.00 | 1.01 | 5.9 | 4.0 |
| 6 | 5 | 4.8 | .93 | .97 | .98 | 5.4 | -1.5 |
| 7 | 6 | 5.0 | .95 | .98 | 1.00 | 6.0 | 6.3 |
| 8 | 7 | 5.2 | 1.00 | 1.02 | 1.02 | 6.1 | 8.5 |
| 9 | 8 | 5.5 | 1.02 | 1.03 | 1.04 | 6.3 | 7.0 |
| 10 | 9 | 5.9 | 1.06 | 1.04 | 1.05 | 6.7 | 1.0 |
| 11 | 10 | 6.2 | 1.07 | 1.04 | 1.04 | 6.5 | 8.5 |
| 12 | 11 | 6.1 | 1.02 | 1.01 | 1.02 | 6.0 | 3.9 |
| 13 | 12 | 5.4 | .98 | .99 | .99 | 5.7 | -1.0 |
| 14 | 13 | 5.0 | .94 | .96 | .97 | 5.8 | 5.9 |
| 15 | 14 | 4.7 | .90 | .93 | .95 | 5.1 | 7.0 |
| 16 | 15 | 5.1 | .97 | .98 | .99 | 6.0 | 9.3 |
| 17 | 16 | 5.4 | 1.01 | 1.02 | 1.01 | 6.3 | 6.5 |
| 18 | 17 | 5.9 | 1.07 | 1.07 | 1.05 | 6.7 | 2.1 |
| 19 | 18 | 5.8 | 1.12 | 1.10 | 1.05 | 6.4 | 4.9 |
| 20 | 19 | 6.0 | 1.10 | 1.08 | 1.04 | 6.5 | 8.3 |
| 21 | 20 | 5.3 | 1.02 | 1.05 | 1.01 | 7.0 | 7.5 |
| 22 | 21 | 4.7 | .97 | 1.00 | 1.02 | 6.5 | 9.5 |
| 23 | 22 | 4.3 | .95 | .97 | .99 | 5.4 | 7.3 |
| 24 | 23 | 5.1 | 1.00 | .99 | 1.01 | 6.0 | 6.4 |

*The mean interest rate on government bonds is 2 percent below the mean outside loan rate in a given round.

TABLE A

| Random Number | Value to be Added to Mean |
|---|---|
| 1 | - .5 |
| 2 - 11 | - .4 |
| 12 - 56 | - .3 |
| 57 - 176 | - .2 |
| 177 - 386 | - .1 |
| 387 - 638 | 0 |
| 639 - 848 | + .1 |
| 849 - 968 | + .2 |
| 969 - 1013 | + .3 |
| 1014 - 1023 | + .4 |
| 1024 | + .5 |

The interest rate on government bonds is determined in the same fashion, except that the average is 2% less than the average outside loan interest rate and the values associated with the random numbers are half of the loan values.

Because the round number is incremented during output, all interest rates calculated during the EDIT routine will use a different average from those calculated during output. This difference is apparent only for the interest rates on government bonds. For example, capital bonds which are floated as inputs to round 3 have an average interest rate of 3.7%. A current bond floated during the simulation executed to produce Round 3 to cover a department deficit would have an average interest rate of 3.3%. (See Figure 1.)

Return on Conservative and Speculative Investments - The average return on conservative and speculative investments is the same for each team in a given round, but a standard value (described in the Players' Manual) is applied to that average for each team. The standard value applied is derived from a table similar to, but with wider diversity than, Table A above. For example, in round 2 one owner of conservative stocks may have the value of his investments increased by 6.3 percent (the average) but another owner may have his increased by 8.0 percnet.

b. Federal-State Aid

Two government departments (SC and MS) receive federal-state aid automatically for certain current programs. The School Department receives two federal-state aid dollars for every local dollar spent on welfare, up to the limit

Three government departments (SC, HY, and PZ) may request and receive federal-state aid for capital projects. These departments must match the federal-state aid received with specified amounts of their own funds. Each aid request for a capital project has a specified probability of being funded in a given round. These conditions are summarized below:

| Department | Project | Maximum Number of Requests | Matching Ratio (F-S to Local | Probability |
|---|---|---|---|---|
| SC | Build or Upgrade Schools | 3 | 1:1 | .60 for first request<br>.40 for second request<br>.30 for third request [a/] |
| HY | Build HY1<br>Build HY2<br>Build HY3 | 30 road segments in total [b/] | 1:9<br>1:1<br>2:1 | .80<br>.50<br>.30 |
| PZ | Purchase | 3 | N/A | .15 [c/] |

a/ The probability increases as the jurisdiction public school enrollment averages more than 18,000 per school, and decreases as the average enrollment is less than 18,000.

b/ Or five separate Federal-State aid requests, whichever comes first.

c/ The probability decreases with the amount requested and as the population per square mile of parkland exceeds 100,000 persons.

A department that receives federal-state aid may spend that aid in the following round or any round thereafter. In other words, the aid is granted and the department can spend the aid whenever it pleases. In the case of SC and HY, the aid must be spent on the specific construction project for which it was requested. For example, if the proposed SC1 at 10842 received the federal-state aid, the aid can only be used for that specific proposed school. The federal-state aid for PZ is not tied to a particular location. Therefore, it can be used to purchase parkland or PI anywhere in the system.

The game director may at his own initiative or in response to player requests, develop any new federal-state aid program by using his $CASH prerogatives, i.e., he can input cash to any economic or government account. This option has been used on many occasions to simulate such federal programs as Model Cities, Urban Renewal, Low Cost Housing Support, Mass Transit Demonstration Grants, Small Business Administration, Labor Department Training Grants, etc.

c. Federal-State Taxes

Federal - Federal personal and business income taxes are paid by local system population units and businesses. The federal income tax rates are:

| Taxpayer | Rate |
|---|---|
| PH | 12% of employment income |
| PM | 6% of employment income |
| PL | 3% of employment income |
| Businesses | |
| Of first $25,000 net income | 22% |
| Of remainder of net income over $25,000 | 48% |

These federal tax rates do not change during the play.

State - State sales taxes are paid by all private purchasers of goods and services whether the selling establishment is in the local or Outside System. The state sales tax is fixed at 3% of total expenditures for goods and services.

d. Migration

The game director has the option both of choosing one of two methods of migrating Pl's and of directly affecting migration results by specifying the number of in-migrants by class. The details of the migration module are explained in section J of this Appendix. With respect to the Outside System, however, it is important to recognize that the people moving in and out of the local system also operate within a larger national system. That is, to the extent that the local system attracts on the net migrants from the Outside it will grow at a faster rate than natural population growth alone would allow. Conversely, if local conditions are such that there is a net out-migration from the local system to the Outside System, then the local population will stabilize or decrease depending upon the extent of the out-migration.

e. Auction and Bids

Local system decision-makers are dealing with the Outside System any time they make a bid to purchase a piece of land that is not owned by someone in the local system. The value of the land owned by the Outside System is calculated by using a formula that takes into account the location of the land with respect to terminals, residences, employment and road access. The formula also takes into account the zoning of the parcel and whether or not it has utility services. More specifically, the value of a computer-owned parcel is calculated so that:

Each round, six outside-owned parcels are selected randomly to be auctioned to the highest bidder. The value of outside-owned land is determined each round from:

| | |
|---|---|
| PRICE | which equals the full market value of an outside-owned parcel |
| VALUE | which equals the average for 100% value for 100% of privately owned and undeveloped parcels (a minimum of $64,000) |
| POINTS | which equals the sum of the parcel's points as described below |
| PRICE | which equals $\frac{\text{value X points}}{50} + \frac{\text{value}}{15}$ |

For each parcel, points are calculated on the following scale:

Distance to nearest terminal (miles):

| Distance | 0 | 1 | 2 | 3 | 4 | 5 | 6+ |
|---|---|---|---|---|---|---|---|
| Points | 45 | 40 | 35 | 30 | 25 | 20 | 5 |

Distance to nearest residence (miles):

| Distance | 0 | 1 | 2 | 3 | 4 | 5 | 6+ |
|---|---|---|---|---|---|---|---|
| Points | 18 | 15 | 12 | 9 | 6 | 3 | 0 |

Distance to nearest employment (miles):

| Distance | 0 | 1 | 2 | 3 | 4 | 5+ |
|---|---|---|---|---|---|---|
| Points | 25 | 20 | 15 | 10 | 5 | 0 |

Utilities: 20 points if present; 0 if not

Zoning Classification:

| Zoning Code | 10's | 20's | 30's | 40's | 51 | 52 | 53 | 60's |
|---|---|---|---|---|---|---|---|---|
| | 25 | 20 | 20 | 15 | 3 | 6 | 12 | 0 |

Road Access:

For each road whch enters an intersection at a corner of the parcel but does not border the parcel (a maximum of 8 roads).

| Road Level | 1 | 2 | 3 |
|---|---|---|---|
| Points | 1 | 2 | 3 |

The probability of a bid being accepted depends upon the amount of the bid in relation to the value of the land as calculated by the land value formula, competing bids, and the type of bid (an auctioned parcel or an unsolicited bid). The probabilities and computer procedures for land bids are described in the CITY IV Players' Manual.

f. Construction Industry

The game director controls the construction module in that he may determine whether or not local construction industries will be employed in a play. Use of local CI's also means that a year time lag for construction is in effect and that the cost of outside construction becomes 130 percent of normal construction costs.

Several land uses can be constructed only by outside firms. These are:

| | | | |
|---|---|---|---|
| CI | = $120 m | Surface Rail Track | = $4 m/mile |
| UT Plant | = $ 30 m | Underground | |
| Rail Station | = $ 1 m | Rail Track | = $14 m/mile |

The remainder of the land uses may be constructed by either local or outside construction firms. When CITY IV is being played without local CI's, development costs for outside construction are equal to typical costs. When local CI's are being employed, then outside construction costs are 130 percent of typical costs.

g. Suppliers of Goods and Services

Some goods and services are purchased only from the outside:

1. BG and BS requirements (regular plus maintenance)

2. Bus and rail rolling stock (purchase and maintenance)

3. Highway maintenance

4. Utility service to parcels and (operating costs)

5. All transportation and terminal expenses

The purchase of other goods and services are made either from local firms or from the outside depending upon the capacity, prices and location of local establishments; boycotts on the part of the consumers; transportation access; and contractual shopping agreements.

Since Outside System prices are fixed (at 130 percent of typical inside prices), the Outside firms offer an effective upper limit on the price that can be charged by local monopoly or colluding firms. Whereas all local firms have finite capacities to sell goods and services, the Outside System has an infinite capacity in so far as the demands of the local system are concerned.

## X. BUSINESS PROFITABILITY

The Master Sheets for economic developments show profitability (typical rates of return and breakeven points) for the various land uses. These are provided so that economic decision-makers will have some idea of the annual return that is possible from different investment decisions. The rate of return is the percent of development cost that is earned each round (net income by a development assuming certain conditions. The break-even point is the capacity at which a commercial development must operate in order to cover the fixed and variable costs of staying in business.

### Basic Industry

In calculating estimated net incomes, many simplifying assumptions were made. "Typical" prices for the output of the three basic industries were: HI1 - $190,000 per CU; LI; - $115,000; and NS1 - $110,000, assuming a value ratio of 100 and satisfactory employment requirements. The wage bill, purchases from BG and BS, and utility charges were assumed to be at typical prices.

Transportation, depreciation, taxes, and amortization payments can vary over a wide range. To obtain estimates of this group of annual expenditures, the following assumptions were made: that the travel distance was two miles to the assigned terminal and BG and three to the BS, using per mile travel costs for an HY2; that a municipal service plant with a use index of 110 was used to account for the effect of municipal service quality on depreciation; that the entire construciton cost (a "typical" figure) was entirely financed by a loan at an interest rate of 5% to calculate the amortization payment; that the assessment ratio was 50%, the property tax 3% and the corporate income tax 50%.

With these assumptions, the rates of return obtained were 26% for HI, LI, and NS. These rates represent a sort of "typical average maximum rate of return". That is, it is a rate of return a businessman could expect if all prices were at their typical values, the business cycle was at its average value, and all other variables were at their typical, average or normal value.

### Commercial Business

For commercial enterprises other simplifying assumptions were necessary. Typical prices per CU of output were assumed: BG and BS = $100,000 and PG and PS = $10,000. Each enterprise was assumed to be operating at 80% of design capacity. In terms of CU's sold this is: BG = 4000, BS = 1200, PG = 12,800, and PS = 6400. Costs such as the wage bill and utility charges are constant for industries;

whereas purchases of goods and services vary with output, but the relationship is a linear one and therefore easily calculated. The same assumptions were made for commercial enterprises as for basic industry with regard to transportation, depreciation, amortization payments and taxes. The rates of return obtained were: BG = 29%, BS = 41%, PG = 29% and PS = 37%. In this case the rates represent some sort of typical return under fairly ideal circumstances. The variability of the rate of return for BS and PS is considerably greater than for BG and PG (as a function of CU's sold). The breakeven point in terms of CU's sold, for each business type (on the above assumptions) was: BG = 2800 (56%), BS = 1065 (71%), PG = 9050 (57%), and PS = 5600 (68%).

Construction Industry

For the construction industry the assumptions above hold except that the wage bill is not constant; rather, it varies proportionately with the amount of capacity used. The construction industry pays the costs of transporting equipment to the building site, in addition to the transportation cost to BG and BS. The average distance from construction industry to building site was assumed to be 5 miles. With the construction industry operating at 80% capacity, the rate of return was calculated to be 22%, and the breakeven point was 250 capacity units (25 percent capacity) under fairly ideal circumstances.

Residences

With regard to residences, the relevant assumptions are that the residences are occupied at design capacity. Typical assumed rents paid by the three income classes are: high - $330,000, middle - $200,000 and low - $140,000 per population unit. Construction cost of residences at QI of 100 are set at: RA - $1 million, RB - $6 million and RC - $25 million. Construction costs do not, however, decrease proportionately to the QI; rather they decrease half as fast (see note in Master Sheets for Residence). Rates of return vary depending on the income class for which the residence is built (assuming that the desired income class actually becomes the resident income class).

## XI. THE MIGRATION PROCESS

### 1. Summary

Unlike the employment process, the migration process operates on all three classes at once. First, a percentage of the unemployed and underemployed Pl's are moved out of the local system thus vacating their local housing. Then, for any housing which remains over 120% occupied (such would be the case if a fully occupied residence unit were partically or totally demolished), enough Pl's are removed to reduce the occupancy to 120%. A percentage of the total population, selected randomly from each class, also vacates its housing. Another 10% of the local population is selected to vacate its housing due to dissatisfaction.

After all of the local movers have been selected and have vacated their housing, they, together with inmigrants and natural population growth, seek housing in the local system. Those who do not find housing leave the local system.

### 2. Index Calculations

The diagram on the next page shows the components of each index which contributes to the Quality of Life Index.

The Environmental Index is a characteristic of a parcel; the Personal Index is a characteristic of people.

#### a. Environmental Index

##### (1) Pollution Index

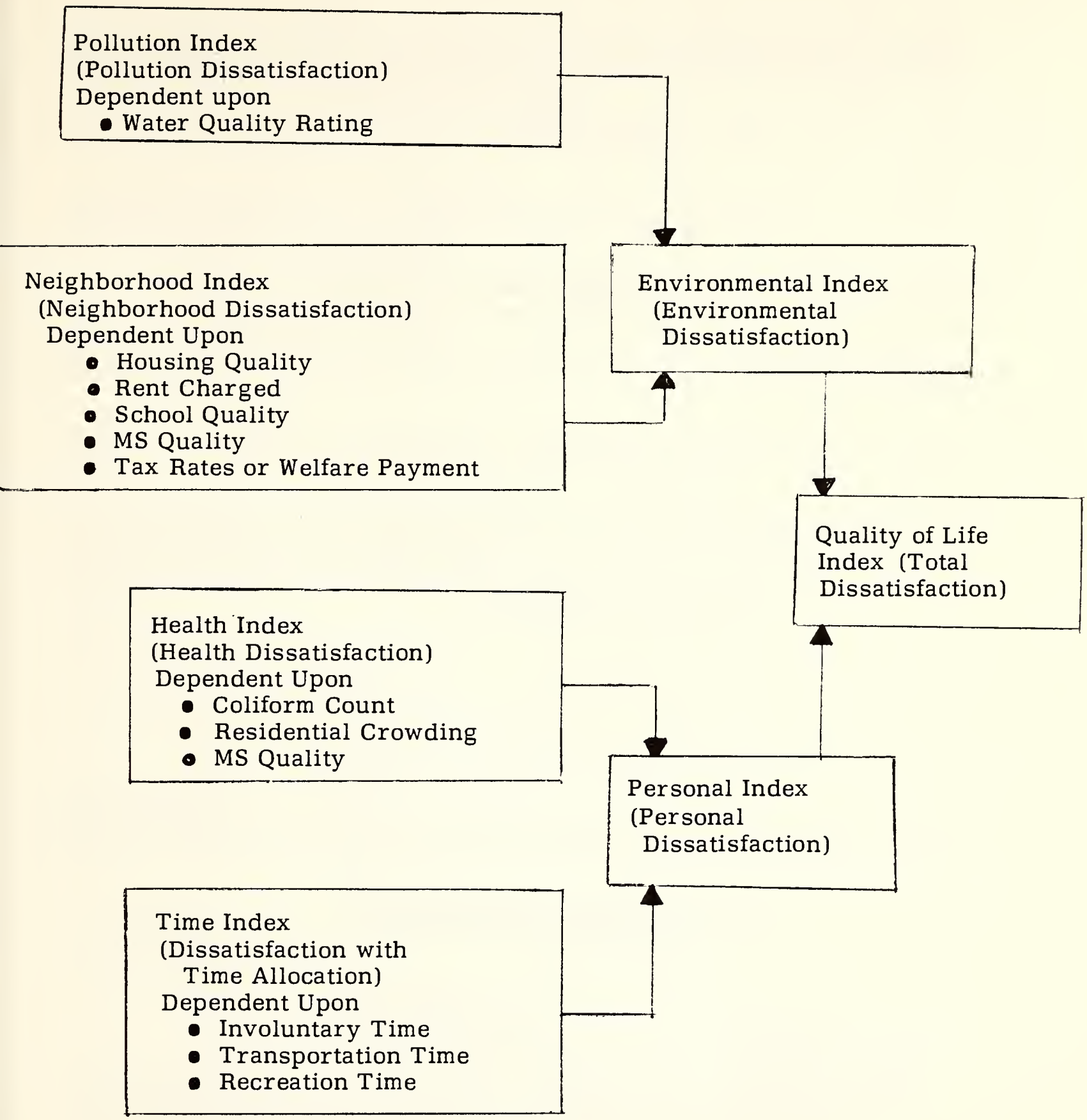
If a parcel has surface water, the pollution index is:

$$(W-3.5)^3$$

where W is the surface water quality rating this year.

If a parcel does not have surface water but does border (on at least one full side) a parcel which has surface water, its pollution index is half of the average pollution indexes of those parcels which it borders and which have surface water.

COMPONENTS OF THE QUALITY OF LIFE INDEX



(2) Neighborhood Index (No components of the Neighborhood Index can be negative)

(a) Residence Quality:

$$C-Q$$

where Q is the residence quality index this year and C is a constant which varies by class (for low, C=70; for middle, C=90; for high, C=100)

(b) Residence Rent:

$$(R-T) * D$$

where R is the rent charged per space unit at the residence this year

and T is the typical rent charged to the class (a loaded data base parameter)

and D is a constant which varies by class (for low, D=3; for middle, D=2; for high, D=1)

(c) MS Use Index:

$$MS-100$$

where MS is last year's use index of the MS now serving the parcel.

(d) School Use Index:

$$SC-100$$

where SC is last year's use index of the school now serving the parcel.

(e) Tax Rates (for PM and PH only):

1/4 point for each mil resident income, services, and goods tax rate and 1/8 point for each mil land and developments tax rate in the jurisdiction this year.

(f) Welfare Rates (for PL only):

$$(2000-W)/25$$

where W is the welfare payment per unemployed worker in the jurisdiction this year.

(3) Personal Index

(a) Health Index (No components of the Health Index can be negative)

MS: (MS-100)/4

where MS is last year's use index of the MS unit now serving the parcel.

Residential Crowding:

(P-100)/.8

where P is the percent occupancy of the residence last year.

Coliform:

If the parcel has surface water, the coliform component of its Health Index is:

C/4

where C is the coliform parts/MG in the surface water at the time that the surface water is assigned its quality rating this year.

If a parcel does not have surface water but adjoins (touches at least a corner) a surface water parcel, its coliform component is that of the adjoining parcel having the highest coliform component.

This component has a maximum value of 50.

(b) Time Index:

Involuntary Time:

1 point for each time unit in involuntary activity last year.

Transportation Time:

5 points for each average time spent in transportation last year.

Recreation Time:

Subtract 1 point for each time unit spent in recreation last year. For each point over 100 of last year's use index of the park with the highest use index within a 3-parcel radius of the parcel, the time subtracted here is decreased by 1 percent.

3. Outmigration due to unemployment and underemployment

Of those Pl's who are unemployed or underemployed, 33% of PH, 25% of PM, and 15% of PL automatically out-migrate and vacate their housing.

4. Selection of those seeking housing

a. Displaced due to overcrowding

After the outmigrating Pl's described in 3 above are removed from their housing, percent occupancy is recalculated. Pl's are then selected to move out of overcrowded housing (housing over 120% occupied). Usually, overcrowded conditions exist only when residences have been demolished. However, the director may have loaded a city with cases of over 120% occupancy. When more than one class lives on an overcrowded parcel, the displaced Pl's are removed in proportion to the number living there in each class.

b. Most Dissatisfied in the System

A randomly selected half of the 20% of each class's (Pl's with the highest Quality of Life Indexes) move out of their housing. The total number of Pl's used here includes those unemployed and underemployed who automatically outmigrate.

c. Randomly Chosen in the System

Of the other 80%, a random 1% of Pl's, 5% of PM's and 7% of PH's cacate their current housing.

d. In-Migrants*

The number of in-migrants from the Outside System in any class is 1% of the number in the class in the local system plus one Pl for each job which is vacant at the beginning of this round (in HI, LI, NS, BG, BS, PG, PS, CI, Bus, Rail, SC, and MS). The number of jobs previously filled but which have been eliminated due to demolition or cutbacks are subtracted from the vacancies counted.

e. Natural Population Growth*

1 - 1/2% of the total population of each class is added to the number of in-migrants in order to represent the natural population growth.

---

*The director may use his control over the absolute number of in-migrating population units by class to override the calculations of number of in-migrants and natural population growth.

5. Housing Placement

The list of Pl's looking for housing is randomly ordered. Each Pl takes the best (lowest Environmental Index) acceptable* available housing. If the best housing would be over 120% crowded if the Pl were to move in, the Pl looks at the second best acceptable housing. (A residence's Environmental Index is raised 1 point for every 1% over 100% occupancy.)

Those who vacated their housing for reasons of dissatisfaction or random selection who cannot find acceptable local system housing with an Environmental Index below their previous Environmental Index will out-migrate. The other types of housing seekers outmigrate only if they cannot find acceptable housing.

Within a single migration cycle, a Pl which vacates its housing for any reason cannot move back into that housing.

When a Pl moves into a residence, its education level and voter registration are averaged with those of the inhabitants in its class and it takes the same preferred time allocation as the previous residents. If a Pl moves into a residence which was previously unoccupied by its class, its characteristics and preferred time allocation are the same as they were at its previous residence location, or, in the case of new in-migrants, the characteristics and preferred time allocations shown in the table below.

| | Class | | |
|---|---|---|---|
| Time Allocation Units | PL | PM | PH |
| Extra job | 40 | 30 | 20 |
| Free Education | 20 | 30 | 0 |
| Pay Education | 0 | 5 | 20 |
| Politics | 10 | 20 | 40 |
| Recreation | 20 | 10 | 10 |
| Characteristics | | | |
| Education Level | 15 | 55 | 85 |
| Voter Registration | 100 | 40 | 200 |
| Previous Savings | 0 | 0 | 0 |

*Acceptable housing is housing with a QI ranging from 20 to 70 for low, 40 to 100 for middle, and 71 to 100 for high.

If more than one Pl moves into a housing unit previously unoccupied by that class and the Pl's have different characteristics (time allocation, education level, voter registration, and previous savings), the characteristics of the first Pl group to choose the housing are assumed for all the Pl's.

A Pl which moves from one place in the loca system to another keeps its previous job location. Although its previous job may not turn out to be its best job after the move, there is still the bias toward retaining the previous job.

## XII. OPERATING PROGRAMS OF THE CITY MODEL: 360 VERSION

1. MIGRAT - main migration driver.

   HSDSST - calculate and stores dissatisfaction indices for all Pl's on board.

   GETCUT - determines what personal dissatisfaction constitutes a 20% cutoff point for each class.

   MOOUT - determines how many Pl's of each class on each residence working at each employment location will move out for reasons of 1) unemployment, 2) underemployment, 3) mobility, or 4) dissatisfaction.

   UNCRWD - calculates percent occupancy of each residence and determines how many Pl's of each class on each residence must move out as a result of overcrowding.

   DISPLC - determines how many Pl's of each class on each residence working at each employment location will move out in order to move out enough to satisfy UNCRWD's requirements.

   INMIG - determines how many immigrants will move in and how much population growth there will be.

   SETUP - determines where Pl's will move into, using

   PICKRS - finds best available acceptable housing.

   MOIN - does actual moving in of Pl's as determined by SETUP.

   JANOUT - prints migration detail.

   MIGSUM - prints migration summary.

   KLEAR - tidies up after demolitions.

2. GAILMN - calculates water usage, pollution, water quality.

3. EDORD - orders Pl's of each class according to education level.

4. DEPREC - depreciates private developments, retaining what VR was after depreciation, then set VR to maintenance level if higher than VR.

5. ASVSET - determines assessed values of private properties depending on assessment input and land and building market value.

6. EMP - employment optimizer - determines full time employment locations for all Pl's - uses transportation.

7. TRTRC - full time employment transportation route trace - uses transportation to determine and print out employment transportation routes and costs.

   TRTRC reiterates using

   CONGES - determines road and rapid transit congestion after each iteration of TRTRC

8. EMPRT - part-time employment optimizer - uses transportation - prints part-time work allocation.

9. SETCAP - determines capacity of businesses based on employment and value ration.

10. EMPSUM - prints out employment summary.

11. LOADMS - determines load on MS's - depreciates and renovates MS's.

12. MSQUAL - stores use index of MS serving each residence and business.

13. LOADSC - determines which Pl's will go to school outside system - determines load on schools - depreciates and renovates schools.

14. NSPACK - determines available and requested adult education - allocates time for adult education.

15. TMALC - determines allocation of time - how much time goes into involuntary - modifies voter registration in accordance with politics time and time and education level in accordance with adult education time - allocates Pl's to parks and determines park use indices.

16. ONAC - does construction contracts accounting - alters status of contracts based on CI capacities and transfers funds for contracts.

17. PRCSET - determines prices industries will get for output - determines maintenance costs for BG and BS - determines property taxes for businesses and residences.

18. SETCOM - determines commercial requirements for Pl's businesses, and residences.

19. OPCM - commercial optimizer - uses transportation.

20. COMDIG - prints commercial diagnostics.

21. TERMS - terminal optimizer.

## OUTPUT SECTIONS

22. PRYMAN - private output driver.

23. WRYOU - social output.

24. WRRES - residential.

25. WBUSS - business.

26. ECBOY - economic boycott.

27. LANDO - land summary.

28. CONIN - CI contracts.

29. FLSTA - financial statement.

30. LOSTA - loan statement.

31. UTS - utility

32. PWS - municipal services.

33. PZ - planning and zoning.

34. SCHOUT - school

35. HYWAY - highway.

36. BSRROT - bus and rail.

37. CHIO - chairman.

38. GOVMNT - government summary.

39. IDEMEC - summary statistics.

# APPENDIX H

## OPTIONAL GAME FORMATS AND SUGGESTIONS

APPENDIX H: Optional Game Formats and Suggestions

As described in Chapter II there are a number of areas for variability in the game format of CITY MODEL. This appendix will serve as a further extension of those formats. It should be emphasized that these role descriptions are guidelines intended as an exemplary framework from which the game director can focus specific issues and applications relevant to a particular group or play.

1. Mass Media

This role performs a communication function presently absent in the formal structure of the model. In a gameroom context the mass media would control and use blackboards, a public address system or podium, copying machines for leaflets, etc. Responsibility for this role is analogous to that of a newspaper, radio station, or television station in the community. Indeed, depending on the size of the group playing CITY MODEL, it may be desirable to have competing newspapers and television stations that vie for credibility and support from the game players, while exerting influence through advertizing, public notices, announcements, editorials and campaign speeches.

The mass media may be established in one of several ways. An open auction or closed bid, conducted by the game director, could award the mass media to the highest bidder. In this case, a bidder must have available cash to pay the auction bid price. Payment for the mass media would be accomplished by a cash transfer of funds from the successful bidder's account to the outside system. Since social decision-makers have no cash transfer capability, they would have to propose imaginative arrangements to bring about a consortium of roles to manage the mass media. Another way to establish the mass media would be simply through designation by the game director. The mass media sets its own charges for for "air time" and "newspaper space." These charges to users would be accomplished by cash transfer decisions.

2. Federal-State Aid Controller

This role performs a channeling and dispensing function for financial aid, presently handled in a probabilistic manner in the model. Responsibility in this role is analogous to that of a Federal or State agency lending funds and granting assistance to municipalities on a shared or matched basis. Since most funding for the municipal departments in the CITY MODEL is accomplished through the computer, this role could function as a "pork barrel" of federal funds to be distributed at the discretion of the F-S controller. These funds could be in addition to those requested via computer decisions. One basis upon which the departments would be eligible for funds could be through an application proposal to the F-S controller. Such applications, stating the need, objectives, and intended use of requested funds, could be reviewed by the F-S controller and funds could be allocated in accordance with a pre-determined goal or priority, or at the direction of the controller.

The F-S controller may be selected by the game director, voted in by the social sector, or hired from a series of applicants by the municipalities. Funds are made available for this role via cash transfers from the Outside System. Annual funds should reflect the status of the National Business Cycle, (i.e., upswing or downswing); or the game director may replicate stodgy congressional appropriations with funding cut-offs in certain areas, (i.e., no money for education, only for crime prevention through MS department). The game director should specify an upper limit for the F-S controller each round.

3. Data and Information Consultant

This role allows advice and information retrieval to be profitable for an economic decision-maker or government department that chooses to accept the responsibility. With control of the employment and shopping diagnostics, along with land values, and summary data, this role has a "corner" on information useful but not essential to other game players. Thus, this role is analogous to an economic or social survey consultant offering analytical information (at a price) to government and business interests.

The Data and Information Consultant may be established through a bid or auction procedure similar to that described in the mass media. Once designated, the D & I consultant is able to charge his own rates for consultation on data. These charges would be accomplished by cash transfer decisions, except in the social sector where information might be available free or for a non-cash charge such as traded votes, etc.

4. Alternative Forms of Government

There are numerous variations on a chief executive/elected council that are available as a governmental form. The structure of the model easily accommodates an elected mayor with no council, an elected payor with council, an appointed city manager with or without council, or finally a council alone. Obviously, group executive decision-making has its drawbacks, but the council option may provide a useful lesson. When configuration of more than one jurisdiction is used, exeuctive decision-making may be combined and coordinated, but departmental decisions remain bounded by jurisdictional lines.

This does not preclude an executive body similar to a Metropolitan Council of Governments with advisory and policy-making powers that affect member jurisdictions.

The chief executive (Chairman) in CITY MODEL can be elected for a term of variable length, while the terms of councilmen may either coincide or overlap. Overlapping terms insures some continuity in the executive process which is useful in a gaming situation where players are initially unfamiliar with many roles.

Since the chief executive in CITY MODEL is elected by the population, he must run on a platform that appeals to a majority of voters. This platform can represent a spectrum of ideology from socialism to dictatorship.

5. Legal System

The CITY MODEL format can operate without a legal system, and does so on a default basis with the game director providing regulations as needed. However, over a number of rounds of play, it may be desirable to establish a formal set of regulation and laws (rules) by which the game players carry out their activities. Such a set of regulations may be termed the "Legal System." The legal system acts as the vehicle to enforce laws and regulations established by the council, and/or chairman through a judiciary and penal code.

A judge (or judges) may be either elected at large from the group of game players, or be appointed by the chairman or game director for a specified term (minimum of 3 rounds is suggested). A penal code can be drawn up during the first round (or pre-determined and ratified by the population units as a referendum). Thereafter, amendments may be drawn up by the judiciary, and approved by the council and/or chairman.

6. Insurgency

This activity, at the discretion of the game director, could be performed by any player willing to accept the potential consequence of punishment via the penal code. For instance, a player may decide to "blow-up" an industry which he and others are striking against for higher wages. The effects of this action will be borne out in future rounds for everyone to observe: loss of potential jobs, reduction of tax base, loss of investment, surplus of labor, lowered wages elsewhere, etc. "blowing up" a development can be accomplished by submitting a demolish decision. The player(s) responsible for this decision must identify themselves to the judiciary and their subsequent escape or arrest will be determined on a random basis proportional to typical crime statistics, (i.e., rolling dice four times to obtain four 6's might mean escape, while failure to do so would subject the player(s) to the penal code.

The penal code might call for player "imprisonment" for 3 rounds with loss of 1/2 of his assets and all decision-making power. In the case of Social Sector players, there might be loss of voting rights, loss of jobs, and loss of decison-making ability. (Loss of jobs could be accomplished by submitting boycott decisions against primary employers in the system.)

7. Holding Corporations

This technique is fairly common in the business world, and allows several economic decision-makers to divide or combine assets for specific purposes. For instance, one economic decision-maker may "buy out" another and use the "bought"

role as a finance company for making loans to other players; or perhaps all highrise housing may be combined, operated, and maintained under one "umbrella" corporation. Such a technique could demonstrate the effectiveness of "single purpose" corporations to the game players. Holding corporations can be set up by simply transferring assets and holdings to a vacant decision-making role.

8. Building Inspector

This role allows for a checking and inspection process of all developed facilities, especially dwelling units. Likewise all new construction might be reviewed and approved through the Building Inspector to insure that proposed projects meet minimum standards as expressed in value ratio, maintenance levels, conformance to master plan, etc.

The Building Inspector could be appointed by the game director or Chairman, or a member of the Planning and Zoning department could serve as Building Inspector in an ex-officio capacity.

9. Citizen Commissions

There are several bodies of representative citizens that may be implemented to focus on specific functions during play of CITY MODEL.

a. A Planning Commission, composed of citizen representatives elected from (pre-defined) wards, would serve a deliberative appeal and approval function, while the Planning and Zoning Department would serve as a staff function. Issues and policies would be directed from the Commission to be articulated in plan terms by the Department staff. The commission would be directly responsible to the population, while the department would be responsible to the commission, and to the Chairman. Ex-officio members could then be added at the discretion of the game director.

b. A School Board, composed of citizen representatives elected from each of the School Districts, whose functions would be analogous to those of the Planning Commission, but focused on matters of educational policy.

c. A Transit Commission, composed of citizen representatives elected at large, whose functions would be analogous to those of the Planning Commission, but focused on matters of transportation policy dealing with the Bus, Rapid Rail, and Highway Departments.

d. A Model Cities Commission, composed of citizen representatives elected from a designated neighborhood area. This commission would be a deliberative and action group responsible for attaining and implementing special funds made available for their "Model Cities Neighborhood." These funds would be in addition to the normal municipal funding via government departments, and could be available from the Federal-State Aid Controller.

10. Citizen Interest Groups

Informally, players may choose to organize the population units they represent in a number of ways to make their voices heard more effectively.

a. Ad Hoc Committees to focus on specific issues such as school quality, overpricing, housing quality, etc., could be made up of those decision-makers concerned enough about an issue to mobilize and act as a coalition.

b. Pressure groups might consist of decision-makers or population units with common goals and interests such as land-owners, people on welfare, purchasers of Business Services, etc. Such groups could develop a residual attitude and policy which would represent an identifiable force in the political process.

c. Unions might consist of low and middle income population units working at an HI plant, or perhaps a white collar union of high income workers at an NS establishement. These organizations could articulate the goals and desires of their constituency and be compsed of a representative hierarchy.

d. Political parties could be formed by social decision-makers who would register their population units at the beginning of play based on a given philosophy for each party. Such a structure might encourage patronage in the Government departments along party lines and party ideology.

# APPENDIX I

## SCENARIOS FOR THE FIVE CITY MODEL CONFIGURATIONS

BIG CITY

TRI-CITY

MORAY COUNTY

DUNBEATH

LOTHIAN

# 1. BIG CITY SCENARIO

The city of PORTMOUTH is approximately 133 square miles in area with a population of about 1.03 million. The surrounding NAIRN COUNTY area (which encompasses 492 square miles) has a population of about 513,000 persons.

PORTMOUTH's downtown core, bisected by a bay inlet, is a concentration of commercial and industrial activity nearly a hundred years old.

Until 25 years ago, the downtown area was the focus of employment as well as residential and cultural activities. With its relatively slow population growth, it easily provided room for residential development close to downtown.

However, with the construction of the two rapid rail links extending to the north and northwest as well as a beltway and bay tunnel, a tremendous outward growth ensued. Lower density residential development blossomed on the fringes of the core area, particularly in the suburban NAIRN COUNTY.

Now, the metropolitan area has two satellite industrial centers, one to the north and one to the west of PORTMOUTH, in addition to an older commercial center in the county.

These suburbs have developed where two major highways cross, one of which has direct access to downtown core of PORTMOUTH. These "lifelines" of commuter traffic, more than adequate a few years ago, are choked with traffic and congestion. This condition has given the suburbs further incentive to develop, in hopes of attracting a further incentive to develop, in hopes of attracting a greater portion of the city's work force and consumer market. Even though they are all within the same county jurisdiction, each of these satellite centers is distinctly different.

"Netherly," to the north, is a relatively high income, high quality suburb, with good residential service facilities and an industrial park.

"Wick," to the west, is a medium income, mediocre quality suburb with a good employment base but inadequate residential service facilities.

"Swordale," to the south, is a relatively low-income, low quality suburb with adequate residential service facilities, but with no employment base and relatively poor access to PORTMOUTH downtown core.

Although PORTMOUTH, with its central core of commerce and industry, has comparatively more job opportunities within its boundaries than many cities of similar size, an unemployment problem exists. Nearly 23% of its low-income workers are unemployed, while the county suburbs enjoy full employment.

In addition, the suburbs are growing more rapidly industrially and commercially than the city; jobs are moving outward with population. This poses additional problems to those workers in the city who cannot afford to commute to suburban employment of shopping.

Several recent actions by the city residents have set the tone for political relations between PORTMOUTH and NAIRN COUNTY.

Significantly, they voted to create a metropolitan transit commission. This transit commission, made up of representatives from both PORTMOUTH and NAIRN COUNTY, reviews the development and operation of the Rapid Rail and Bus Systems. The actual appropriations and funding responsibilities remain within the governments of each of the jurisdictions, however.

The rapid rail system, which presently offers fast economical access from "Netherly" to downtown has helped to maintain the livelihood of downtown businesses. But, the rapid rail is merely a linear connection between several points and not an efficient transportation network. The existing bus routes run largely independent of the rapid rail schedules. Thus, the appeal and effectiveness of public transportation is offset by lengthy rides to destinations. Even "close-in" PORTMOUTH residents drive to suburban shopping and employment centers to reduce frustration and travel time.

However, it was the hope of PORTMOUTH politicians, as well as many of its residents, that the further development of a coordinated and balanced transit system would reduce some of the intolerable automobile congestion and cause consumers to start shopping downtown again.

Another significant event was the defeat of a referendum to establish a county-wide joint school system. PORTMOUTH residents passed it overwhelmingly, but it lost by a wide margin in the county. The coalition of liberal upper class suburbanites and inner city residents expended their "political ammunition" on this campaign and felt that the climate for consideration of this issue would not become favorable again for many years.

The county's schools are in very good condition. They have high quality teachers at good salaries, and low student-teacher ratios which afford individual attention to each student. Their physical facilities are almost unsurpassed, since they are the beneficiary of recent advances in construction and educational technology.

PORTMOUTH's schools, on the other hand, are generally in poor condition. The old dilapidated facilities are difficult to modify and costly to improve, creating an atmosphere in which it is difficult to retain teachers or students. A high percentage of the students in PORTMOUTH attending costly private schools are an indication of the problem. On top of these problems, the PORTMOUTH school year, and Ad Hoc Citizens Committee for Improved School circulated a petition calling for increased funding of school improvements. Sixty-six percent of the city's voting population endorsed the petition and it was on the mayor's desk two weeks before the primary election. His inaction on the petition proved to be his downfall in the primary where his opponent made an issue of school spending. He is now completing his term as a "lame duck" mayor, with the upcoming election to decide who will lead PORTMOUTH over the next several years.

## 2. TRI-CITY SCENARIO

Three separate cities comprise the tri-city area: AVIEMORE to the west, BO/NESS to the northeast, and CUMBERNAULD to the southeast. The three cities are interdependent to the extent that workers and goods flow between them, but they are independent as political entities.

AVIEMORE has a concentration of heavy industry, 60% of the total in the entire tri-city area. Its population of 200,000 people of primarily lower-income classes has a relatively high density (5300/sq. mi.) for a city of its size. Its industrial structures are dilapidated and one of its square mile parcels contains the worst slum in the area, whose inhabitants are among the poorest educated in the region. Even housing inhabited by middle and high-income groups is inferior to the housing available in the other two cities.

BO'NESS is an elite high-income town with only two light industries and two business establishments. Its population of 150,000 people has a relatively low density of 3600/sq. mi.. Many high-income class workers take the commuter rail into CUMBERNAULD to work at the industrial and commercial enterprises located there. In the past there has also been some reverse commuter traffic of low-income workers from CUMBERNAULD to BO'NESS to work in the personal service firms there.

CUMBERNAULD is basically a middle-income community with a fairly even balance of heavy and light industry, and national services, and a sufficient component of local businesses. Its population of 250,000 people has a medium density of 4500/sq. mi..

Businessmen in AVIEMORE have been unwilling to hire local low-income workers because of their extremely low level of education. Instead, businessmen hire most of their low-income workers from CUMBERNAULD who travel upwards of 20 miles to their jobs. Consequently, there is extensive low-income unemployment in AVIEMORE and even though the welfare payment per worker is only $600 per annum, the municipal services department is saddled with extremely large welfare expenditures.

A commuter rail line running into BO'NESS from the northeast and continuing on directly south into and out of CUMBERNAULD running parallel to the main highway connects these two cities, which are 19 miles apart. There are also main highways connecting AVIEMORE 24 miles to CUMBERNAULD, and 32 miles to BO'NESS. A regional airport lies on the northern outskirts of CUMBERNAULD.

In addition to the 135 privately owned developed or partially developed square mile parcels overall, there are also a large number of privately-owned, undeveloped parcels. Of particular note are the 16 square miles of completely vacant land (owned by local businessmen) lying between the three cities.

The quality of schools and other public services vary greatly among the cities. BO'NESS has provided its residents with exceptionally good schools and a large amount of parkland relative to the number of people served. Although there is no bus service, BO'NESS has maintained excellence among the remaining municipally supplied services.

CUMBERNAULD has generally maintained high quality public services, except for the section adjacent to and south of the industrial area. Here both the schools and municipal services have dilapidated physical structures and insufficient employees to fulfill the demands placed upon them. The amount of parkland has kept pace with the population growth and bus service is quite good.

In AVIEMORE the municipal government has shown itself incapable of meeting local demands. Even the schools and municipal services in higher income neighborhoods are inferior and many high and middle income parents find it necessary to send their children to private schools. Bus service does exist, but the buses are old and break down so often there is never a full contingent on the road. The amount of new parkland provided has lagged behind population growth.

Together, the three cities of AVIEMORE, BO'NESS and CUMBERNAULD exhibit diverse settings, each with different sets of problems. Thus, appropriate remedies for each of the cities problems are not necessarily the same and very well may conflict with one another.

# 3. MORAY COUNTY SCENARIO

MORAY is a rural county with a population of 11,500, over half of whom are low-income class people. The only urbanized development is located at the intersection of two county trunk roads, one running north-south, and the other running east-west. About 2500 people make their residence near this intersection, while the remainder of the population is spread out along the two county trunk roads.

There are no ongoing businesses of any kind in MORAY COUNTY, nor are there any industries. The only employers within the county are a municipal services plant and a school. Additional employment is available in two nearby cities, beyond the borders of MORAY COUNTY, one to the north and the other to the west. These two cities are separate jurisdictions over which local decision-makers have no control. Thus, the present capacity of the government facilities to employ the residents of MORAY COUNTY is limited to the capacity of schools and municipal service plants in the county and the two adjacent cities. Future employment capacity will depend on MORAY COUNTY's ability to stimulate growth and development, success in gaining federal funds, and the extent of growth and expansion of the two adjacent cities. (It is suggested that the game director or a select group of players could operate the economic activities of the two adjacent cities via cash transfers from the Outside.)

# 4. DUNBEATH SCENARIO

DUNBEATH is a medium sized city of 290,000 population encompassing a developed area of 42 square miles. There is, however, a large amount of privately owned undeveloped land within the core area as well as on the fringe, where zoning was recently obtained for a new industrial park.

The industrial and commercial area is centered within a two to three mile radius of the terminal, which is a focal point in the city. The low-income residential section of DUNBEATH extends into the northeast which contains a garden apartment complex at parcel 10026 comprising the worst slum in the city. The remaining low-income housing is of mediocre quality and generally overcrowded. The public facilities serving the northeast section of town are all inferior to those in the other parts of town. The school in the northeast is overcrowded, with a poor student-teacher ratio of 25-1 and a low value ratio of 65, compared to student teacher ratios of 15-1 or less and significantly higher value ratios in the other schools. The municipal services department is uniformly bad throughout the city as police and fire stations and hiring policies have continually lagged behind DUNBEATH's recent rapid growth. Likewise, the road system in the northeast has been allowed to deteriorate significantly. In addition, the bus service that exists does not serve the low income people of northeast. Finally, the planning and zoning department has failed to provide any parkland at all in the northeast residential area, while providing abundant parkland in the south and northwest.

The southwest section of DUNBEATH is a high-income residential area where all public services, except municipal services, are plentiful and of high quality. The northwest neighborhoods and the few residential developments in the southeast are largely middle income with some higher income people.

The growth pattern of DUNBEATH has been a mad rush of land speculation and almost unrestricted development, with the municipal planning agency nothing more than a tool of the economic interests, granting all zoning changes requested. For this reason new developments have leapfrogged large tracts of undeveloped land to build housing on cheaper land further from the center city. This has resulted in a very uneconomic land use pattern with large totally vacant areas in and near the center of the city, particularly in the northern half of the city. With the election of a new mayor the question now arises whether such policies will continue and scattered development be the inevitable result.

# 5. LOTHIAN SCENARIO

LOTHIAN is a medium sized town of 50,000 people. This city is distributed over an area of 1/9 sq. mile parcels at a relatively low density of about 1,000/sq. mile. Thus, since LOTHIAN urban development occupies most of the board, this scenario will draw attention to intra-city aspects.

The west side is the older section of town and has deteriorated to a low-income residential area. The two heavy industries and the business goods firm have also deteriorated over the years to a point where they are operating at only about 70% of their peak efficiency. A swampy area winds its way from the terminal in a south-westerly direction. The municipal government has periodically proclaimed its determination to drain the swamp to make space available for new homes and parkland, but has not followed through on its promise.

LOTHIAN has grown toward the west along the main highway running east and west, because a new north-south interstate highway was built slightly less than two miles to the east of the older industrial complex. The principal commercial firms are located at the intersection of these two highways, comprising what is essentially the new downtown area. A new light industrial complex has grown up further to the east and the surrounding area has become the high-income neighborhood.

The Deveron River runs through the northeast section adding an appeal for wealthier families because of the scenic and recreational opportunities it offers.

As might be expected, the schools and other public services are better in the newer upper class section of the town than in either the lower or middle class residential sections. The student-teacher ratio and educational program, as well as the physical condition of the structures are all excellent in the northeastern school district. To the west the middle and low-income class areas have relatively poor quality of schooling. The school district in the far western section is inferior to all other districts.

Deteriorated conditions also exist in the case of municipal services. In addition, there is much more parkland in the eastern half of the town, particularly bordering the river, than in the west. The road network provides equally good access for all sections of the town, although the roads are better maintained in the eastern portion. The Bus Department actually serves the low and middle income areas better than the high income areas.

LOTHIAN is currently experiencing extremely high unemployment due to the slackening of new construction. But, it is expected that new construction starts will pick up shortly and the rate of unemployment will fall to no more than 5-6%. The housing vacancy rate is approximately 4% spread fairly evenly throughout the town.

# APPENDIX J

## DEFINITION OF LAND USE TYPES

| CITY IV Symbol | NAME | Standard Industrial Classification Code | Census Industry Group |
|---|---|---|---|
| HI | Heavy Industry (includes some non-durable goods but primarily durable goods manufacturing) | 19 Ordinance | Other durable |
| | | 20 Goods | Food |
| | | 21 Tobacco | |
| | | 22 Textile | Textile |
| | | 23 Apparel | Apparel |
| | | 24 Lumber | Furniture & Lumber |
| | | 25 Furniture | |
| | | 26 Paper | |
| | | 29 Petroleum | |
| | | 32 Stone | |
| | | 33 Primary Metals | Primary ferrous |
| | | | Primary nonferrous |
| | | 35 Machinery | Machinery |
| | | 37 Trans. Equip. | Motor Vehicles |
| | | | Aircraft |
| | | | Other trans. equip. |
| LI | Light Industry (includes some durable goods but primarily non-durable goods manufacturing | 27 Printing | Printing |
| | | 28 Chemicals | Chemicals |
| | | 30 Rubber-plastic | Rubber-plastic |
| | | 31 Leather | Other nondurable |
| | | 34 Fabricated metals | Other durable |
| | | 36 Electrical machinery | Electrical machinery |
| | | 38 Instruments | Other durable |
| | | 39 Miscellaneous | Other nondurable |
| NS | National Service (national type services) | 61 Credit agencies | |
| | | 62 Security dealers | |
| | | 63 Insurance carriers | Insurance |
| BG | Business Goods (goods sold to industries and local commercial) | 50 Wholesale trade | Wholesale trade |
| | | 52 Building materials | |

DEFINITION OF LAND USE TYPES

DEFINITION OF LAND USE TYPES -- continued

| CITY IV Symbol | NAME | Standard Industrial Classification Code | Census Industry Group |
|---|---|---|---|
| BS | Business Services (services sold primarily to businesses) | 73 Miscellaneous Business Services<br>81 Legal Services<br>89 Miscellaneous Services | Business Services |
| PG | Personal Goods | 53 Retail General Merchandise<br>54 Food Stores<br>55 Automotive dealers & service stations<br>56 Apparel and Accessory Stores<br>57 Furniture and home furnishing stores<br>58 Eating and drinking places<br>59 Miscellaneous Retail Stores | General Merchandise<br>Food Stores<br><br><br><br>Eating and drinking places<br>Other Retail |
| PS | Personal Services | 60 Banking<br>65 Real Estate<br>70 Hotels<br>72 Personal Services<br>75 Auto Repair<br>76 Miscellaneous Repair<br>78 Motion Pictures<br>79 Amusements | <br><br>Hotels<br>Other Personal Service<br><br>Repair Services<br><br>Entertainment |
| MS | Municipal Services (excluding education) | | Public Administration (local part only) |
| SC | Schools (public only) | | Education Services<br>Government |
| TM | Terminals | 40 Railroad<br>42 Trucking & warehousing<br>44 Water Transportation<br>45 Air Transportation<br>46 Pipeline Transportation<br>47 Transportation services | Railroads<br>Trucking & warehousing<br><br>Other Transportation |
| RAIL BUS | Rapid rail and bus | 41 Local Urban Passenger Transit | |
| UT | Utilities | 49 Electric, gas, and sanitary services | Utilities & sanitary services |

# APPENDIX K

## CITY MODEL -- SMALL SCALE

## 1. MASTER SHEET FOR BASIC INDUSTRY*

| | HI1 | LI1 | NS1 |
|---|---|---|---|
| Land Development | | | |
| Typical Construction Cost | $10,500,000 | $6,500,000 | $5,000,000 |
| Land Requirement | 28% | 24% | 20% |
| Depreciation and Maintenance Rates | | | |
| Annual Normal (%) | 3.1 | 2.6 | 3.0 |
| As a Result of MS Quality (%) | 3.1Q | 2.6Q | 3.0Q |

(Note: $Q = \frac{\text{MS Use Index} - 100}{100}$)

| | | | |
|---|---|---|---|
| Income | | | |
| Maximum Output (design capacity) | 1000 units | 1000 units | 1000 units |
| Average Price per Unit (set by "Outside System") | $19,000,000 | $11,500,000 | $11,000,000 |
| Expenditures | | | |
| Employment Requirements | | | |
| PH - 12 workers | 21(0) | 15(0) | 23(1) |
| PM - 16 workers | 29(1) | 11(1) | 9(0) |
| PL - 20 workers | 9(0) | 11(1) | 9(0) |

(Note: Numbers in parentheses indicate part-time employment units.)

| | | | |
|---|---|---|---|
| Typical Wage Bill (if at full employment and typical salaries of $10,000, $5,000 and 2,500 are offered) | $5,370,000 | $3,360,000 | $4,050,000 |
| BG and BS Requirements For 1% Maintenance and/or Renovation | | | |
| BG: | 9 units | 4 units | 1 unit |
| BS: | 1.5 units | 2.5 units | 4 units |

*Note that the Basic Industries are divided into eleven SIC categories which can be developed in this small scale simulation.

Master Sheet for Basic Industry - (continued)

| | HI1 | LI1 | NS1 |
|---|---|---|---|
| for Normal Operations | | | |
| BG | 420 units | 190 units | 60 units |
| BS | 60 units | 100 units | 230 units |

(Note: BG and BS can be purchased either from local BG and BS establishments at competitive prices or from the outside system at a fixed price of $13,000 per unit.)

| | | | |
|---|---|---|---|
| Utility Requirements | 402 units | 135 units | 76 units |

(Note: The price for utility service is set by the Utility Department. The "typical" price is $1,000 per unit.)

| | | | |
|---|---|---|---|
| Transportation | | | |
| Charges per distance unit Along HY3 to: | | | |
| BG | $16/CU | $16/CU | $16/CU |
| BS | $16/CU | $16/CU | $16/CU |
| Terminal | $28,000 | $8,500 | -- |

(Note: An HY3 is the least expensive road. Charges are double on an HY2 and triple on an HY1.)

| | |
|---|---|
| Taxes | |
| Local | Local tax rates are set by the Chairman |
| Property | |
| Sales | |
| Federal and State | |
| Business Income (State) | 5% of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax and local sales tax, and minus property tax). |
| Business Income (Federal) | 22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax, minus local sales tax, minus property tax, minus state income tax) plus 48% of rest (minus the same deductions). |
| Sales Tax (State) | 3% of the total purchases of BG and BS. |

## 2. MASTER SHEET FOR THE CONSTRUCTION INDUSTRY

| | CI1 |
|---|---|
| Land Development | |
| Development Cost (equipment units) | $12,000,000 |
| Land Requirement | 20% |
| Depreciation (equipment) | |
| As a Function of Use | .04C* |
| Capacity (equipment units) | 1000 |
| Expenditures | |
| Employment Requirements | 1 population unit of each class per 50 units of labor |
| Typical Wage Bill (if typical salaries of $10,000, $5,000 and $2,500 are offered) | $250,000 per 50 units of labor |
| Per unit of Equipment | |
| BG | .44 units |
| BS | .06 units |

(Note: BG and BS may be purchased either from local BG and BS establishments at competitive prices or from the "Outside System" at "fixed cost" of $13,000 per unit.)

| Transportation Charges per distance unit along HY3 per CU of construction | |
|---|---|
| to BG: | $7 |
| to BS | 1 |
| to Build Site | 2 |

(Note: A HY3 is the least expensive road to travel. Costs are double on a HY2 and triple on a HY1.)

---

* $C = \frac{\text{equipment units used}}{\text{design capacity}}$

CI1

| | |
|---|---|
| Taxes | |
| Local | |
| Property Sales | Local Tax Rates are set by the Chairman |
| Federal and State | |
| Business Income (State) | 5% of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax and local sales tax, and minus property tax). |
| Business Income (Federal) | 22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus local sales tax, minus state sales tax, minus property tax, minus state income tax) plus 48% of rest (minus the same deductions). |
| Sales Tax (State) | 3% of the total purchases of BG and BS. |

## CONSTRUCTION CAPACITY REQUIREMENTS

| Land Use | Construction Units of Equipment | Units of Material | Units of Labor | Demolition Units of Equipment | Demolition Units of Material |
|---|---|---|---|---|---|
| Basic Industry | | | | | |
| HI1 | 525 | 525 | 525 | 105 | 359 |
| LI1 | 325 | 325 | 325 | 65 | 222 |
| NS1 | 250 | 250 | 250 | 50 | 171 |
| Local Service Industry | | | | | |
| BG1 | 135 | 125 | 125 | 25 | 86 |
| BS1 | 50 | 50 | 50 | 10 | 34 |
| PG1 | 150 | 150 | 150 | 30 | 103 |
| PS1 | 50 | 50 | 50 | 10 | 34 |
| Residences* | | | | | |
| RA1 | 5 | 5 | 5 | 1 | 3 |
| RB1 | 30 | 30 | 30 | 6 | 21 |
| RC1 | 125 | 125 | 125 | 25 | 86 |
| Public Structures | | | | | |
| SC1 | 135 | 135 | 135 | 27 | 92 |
| MS1 | 150 | 150 | 150 | 30 | 103 |
| HY1 | 4 | 4 | 4 | 1 | 3 |
| TM1 | 70 | 70 | 70 | 14 | 42 |

*These requirements of equipment, materials, and labor are for residence construction at QI = 100. But, new housing can be built at a lower quality index (as low as QI = 40). Requirements diminish according to the equation: $R = 1/200\ S(100 + X)$ where S is the units of equipment and material or the units of labor required to the same type of residence at QI = X. Using an RC1 as an example, the requirements at QI = 80 are 113, at QI = 60 are 100, and at QI = 40 are 80.

## 3. MASTER SHEET FOR COMMERCIAL ESTABLISHMENTS

| | BG1 | BS1 | PG1 | PS1 |
|---|---|---|---|---|
| Land Development | | | | |
| Typical Construction Cost Land | $2,500,000 | $1,000,000 | $3,000,000 | $1,000,000 |
| Requirements | 24% | 20% | 16% | 12% |
| Depreciation and Maintenance | | | | |
| Depreciation Rates | | | | |
| Annual Normal (%) | 1.5 | 2.0 | 1.6 | 2.2 |
| As Result of MS Quality (%) | 2.5Q* | 3.0Q | 2.6Q | 3.2Q |
| As Result of Use | .015C** | .02C | .016C | .022C |

(Note: $*Q = \frac{\text{MS Use Index} - 100}{100}$

$**C = \frac{\text{(Actual Use of Commercial Establishment)}}{\text{(Effective Capacity of Commercial Establishment)}} - 1$

| | | | | |
|---|---|---|---|---|
| Income | | | | |
| Design Capacity (units) | 5,000 | 1,500 | 16,000 | 8,000 |
| Typical Price per unit | $10,000 | $10,000 | $1,000 | $1,000 |
| Typical Maximum Income | $50,000,000 | $15,000,000 | $16,000,000 | $8,000,000 |
| Expenditures | | | | |
| Employment Requirements | | | | |
| PH - 12 workers: | 14(1) | 20(1) | 8(0) | 6(0) |
| PM - 16 workers: | 7(0) | 9(0) | 13(1) | 11(1) |
| PL - 20 workers: | 8(0) | 9(0) | 22(2) | 16(2) |

(Note: Numbers in parentheses indicate part-time employment units.)

| | | | | |
|---|---|---|---|---|
| Typical Wage Bill (If at full employment and typical salaries of $10,000; $5,000 and $2,500 are offered.) | $2,760,000 | $3,690,000 | $3,280,000 | $2,580,000 |

Master Sheet for Commercial Establishments - (continued)

| | BG1 | BS1 | PG1 | PS1 |
|---|---|---|---|---|
| BG and BS Requirements per unit of output | | | | |
| For normal operation | | | | |
| outside | $8,300 (fixed cost) | $5,800 (fixed cost) | -- | -- |
| BG | -- | -- | .037 units | .03 units |
| BS | -- | -- | .017 units | .01 units |
| For 1% Renovation & Maintenance | | | | |
| Outside | $25,000 (fixed cost) | $10,000 (fixed cost) | -- | -- |
| BG | | | 2 units | .75 units |
| BS | | | 1 unit | .25 units |

(Note: BG and BS can be purchased from either local BG and BS establishments (except for BG and BS establishments which cannot purchase from themselves) at competitive prices or from the "Outside System" at a fixed cost of $13,000 per unit.)

| | | | | |
|---|---|---|---|---|
| Utility Requirements | 112 units | 71 units | 99 units | 77 units |

(Note: The price for utility service is set by the Utility Department. The "typical" price is $1,000 per unit.)

| | | | | |
|---|---|---|---|---|
| Transportation Charges | | | | |
| Per unit of output | | | | |
| Per distance unit on HY3 | | | | |
| from terminal | $13.3 | | | |
| to BG | | | .57 | .50 |
| to BS | | | .27 | .17 |

(Note: An HY3 is the least expensive road. Costs are double on an HY2 and triple on an HY1.)

| | |
|---|---|
| Taxes | |
| Local | |
| Property | Local tax rates are set by the Chairman |
| Sales | |

| | |
|---|---|
| Federal and State Business Income (State) | 5% of (gross income minus salaries minus goods and services payments, minus maintenance payments, minus state sales tax and local sales tax, and minus property tax). |
| Business Income (Federal) | 22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax, minus local sales tax, minus property tax, minus state income tax) |
| Sales Tax (State) | 3% of the total purchases of BG and BS. |

## 4. MASTER SHEET FOR RESIDENCES

| | RA1 | RB1 | RC1 |
|---|---|---|---|
| Land Development | | | |
| Typical Construction Cost (at VR = 100) | $100,000 | $600,000 | $2,500,000 |
| Land Requirement | 12% | 12% | 12% |
| Depreciation and Maintenance | | | |
| Depreciation Rates | | | |
| Annual Normal (%) | 2 | 3 | 4 |
| Result of MS Quality (%) | 1Q | 1Q | 1Q |

(Note: $Q = \frac{\text{MS Use Index} - 100}{100}$)

| | | | |
|---|---|---|---|
| Design Capacity | | | |
| PH | 1 | 6 | 25 |
| PM | 1.5 | 9 | 37.5 |
| PL | 2 | 12 | 50 |
| Rent | | | |
| Typical Rents/PL1 | | | |
| PH tenants | $16,500 | $16,500 | $16,500 |
| PM tenants | 15,000 | 15,000 | 15,000 |
| PL tenants | 14,000 | 14,000 | 14,000 |
| Income Typical Rent at Design Capacity | | | |
| PH | 33,000 | 198,000 | 825,000 |
| PM | 30,000 | 180,000 | 750,000 |
| PL | 28,000 | 168,000 | 700,000 |
| Expenditures | | | |
| PG and PS requirements | | | |
| For 1% renovation or maintenance | | | |
| PG | .7 units | 4 units | 17 units |
| PS | .3 units | 2 units | 8 units |
| Utility Requirements | 4 units | 26 units | 117 units |

(Note: PG and PS may be purchased either from local PG and PS establishments or from the "Outside System" at a fixed price of $1,300 per unit.)

(Note: Prices for utility service are set by the Utility Department. The "typical" price for a unit of service is $1,000.)

Master Sheet for Residences - (continued)

| | |
|---|---|
| Taxes<br>Local<br>Property<br>Sales | Local tax rates are set by the Chairman |
| Federal and State<br>Business Income<br>(State) | 5% of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax and local sales tax, and minus property tax). |
| Business Income<br>(Federal) | 22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax, minus local sales tax, minus property tax, minus state income tax), plus 48% of rest (minus the same deductions) 3% of the total purchases of PG and PS. |
| Sales Tax<br>(State) | 3% of the total purchases of PG and PS. |

## 5. MASTER SHEET FOR SOCIAL SECTOR

| | PH | PM | PL |
|---|---|---|---|
| Population Characteristics | High | Middle | Low |
| Number of People | 50 | 50 | 50 |
| Number of Workers | 12 | 16 | 20 |
| Number of Students | 13 | 14 | 10 |
| Normal Number of Registered Voters | 20 | 14 | 10 |
| Educational Range | 70-99 | 40-69 | 0-39 |
| Economic Characteristics | | | |
| Typical Salary per Worker | $10,000 | $5,000 | $2,500 |
| Typical Salary per Population Unit | $120,000 | $80,000 | $50,000 |
| PG and PS requirements | | | |
| PG | 34 units | 28 units | 21 units |
| PS | 16 units | 11 units | 7 units |

(Note: PG and PS may be bought from local PG and PS establishments at competitive prices (about $1,000 per unit) or from the "Outside System" at a fixed price of $1,300 per unit.)

| | | | |
|---|---|---|---|
| Typical Rents | $33,000 | $20,000 | $14,000 |

(Note: Rents are set by economic decision-makers. Actual rents may range above or below these figures.)

| | | | |
|---|---|---|---|
| Transportation Charges | | | |
| Travel to Work by Auto | | | |
| Base Cost | $210/worker | $190/worker | $140/worker |
| + | | | |
| Distance Unit Cost on | | | |
| HY1 | $20/worker/DU | $18/worker/DU | $16/worker/DU |
| HY2 | $16/worker/DU | $15/worker/DU | $13/worker/DU |
| HY3 | $13/worker/DU | $12/worker/DU | $10/worker/DU |
| Travel to Work by Bus | Rates set by Bus Company | | |
| Travel to PG by Auto | | | |
| Cost per Distance Unit on HY3: | $2 per Unit consumed | $2 per Unit consumed | $2 per Unit consumed |

Master Sheet for the Social Sector - (continued)

| | PH | PM | PL |
|---|---|---|---|
| Travel to PS by Auto Cost per Distance Unit on HYConsumed | $2 per Unit Consumed | $2 per Unit Consumed | $2 per Unit |
| Cost of Private Education | $3,750 | $2,500 | $1,250 |
| Taxes | | | |
| Local | Local tax rates set by Chairman | | |
| Sales | | | |
| Income | | | |
| Federal-State | | | |
| Sales | 3% of total purchase of PG/PS | | |
| Income | 12% (wages) | 6% (wages) | 3% (wages) |
| Social Characteristics | | | |
| Units of Time to Allocate | 100 time units | 100 time units | 100 time units |
| Time Consumption | | | |
| Travel to Work per Distance Unit on Uncongested | | | |
| HY1 | 1 time unit | 1 time unit | 1 time unit |
| HY2 | .67 time units | .67 time units | .67 time units |
| HY3 | .33 time unit | .33 time unit | .33 time unit |
| By Bus Per Distance Unit on | | | |
| HY1 | 1.3 time units | 1.3 time units | 1.3 time units |
| HY2 | 1 time unit | 1 time unit | 1 time unit |
| HY3 | .67 time units | .67 time unit | .67 time unit |
| Waiting | 1 time unit | 1 time unit | 1 time unit |
| Walk | .33 time unit | .33 time unit | .33 time unit |

(Note: Highway congestion (for auto or bus) increases time consumption in direct proportion to the amount of congestion that occurs.)

Master Sheet for the Social Sector - (continued

| | PH | PM | PL |
|---|---|---|---|
| Extra Work | | | |
| Units of Time for Full-Time Job | 80 | 80 | 80 |
| Typical Salary per time unit | $1,500 | $1,000 | $625 |
| Adult Education | | | |
| Annual Time Units required to maintain maximum education level | 27 | 20 | 26 |
| Cost per Time Unit for private adult education | $300 | $300 | $300 |
| Politics | | | |
| Units of Time for 7% increase in voters | 10 | 10 | 10 |
| Units of time for 15% increase in voters | 60 | 60 | 60 |
| Recreation | | | |
| Units of PG per unit of time | .1 | .05 | .025 |
| Units of PS per unit of time | .075 | .05 | 0 |

## 6. MASTER SHEET FOR THE SCHOOL DEPARTMENT

### General Characteristics

| | SC1 |
|---|---|
| Land Development | |
| Typical Construction Cost | $2,700,000 |
| Land Requirement | 16% |
| Depreciation and Maintenance | |
| Annual Depreciation Rate | 2% |
| BG and BS Requirements | |
| For 1% Renovation or Maintenance | |
| BG | 2 units |
| BS | 7 units |
| For Normal Operation | |
| BG | 8 units |
| BS | 3 units |
| Federal-State Aid | |
| Capital | $1 for every local $1 |
| Current (automatic) | $225 per student |

### Design Capacity (students) as a Function of Employment Mix

| PM Teacher Units / PH Teacher Units | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 0 | | 252 | 414 | 684 | 990 | 1,224 | 1,314 |
| 1 | 360 | 591 | 846 | 1,120 | 1,332 | 1,530 | 1,710 |
| 2 | 720 | 990 | 1,260 | 1,550 | 1,746 | 1,944 | 2,124 |
| 3 | 1,080 | 1,404 | 1,692 | 2,000* | 2,196 | 2,376 | 2,556 |
| 4 | 1,314 | 1,746 | 2,106 | 2,340 | 2,520 | 2,700 | 2,862 |
| 5 | 1,710 | 2,070 | 2,340 | 2,664 | 2,844 | 3,000 | 3,150 |
| 6 | 1,980 | 2,385 | 2,682 | 2,988 | 3,132 | 3,285 | 3,420 |

*The least cost design capacity of an SC1.

(Note: There are 12 teachers in a PH and 16 teachers in a PM.)

Master Sheet for the School Department - (continued)

## Population Unit Characteristics

| Characteristics | PH | PM | PL |
|---|---|---|---|
| Number of students | 13 | 14 | 10 |
| Criteria for Refusal to attend Public Schools | | | |
| Value Ratio (Min.) | 80 | 60 | |
| Student-Teacher Ratio (Max.) | 18:1 | 22:1 | |
| Ratio of High to Middle Teachers (Maximum) | | | |
| Ratio of High to Middle Teachers (Minimum) | 1:1 | 3:4 | |
| Cost of Private Education (for students) | $3,750 | $2,500 | $1,250 |

## Capital Federal-State Aid

1st Request: 60% chance of acceptance when students/school = 1,800

2nd Request: 40% chance of acceptance when students/school = 1,800

3rd Request: 30% chance of acceptance when students/school = 1,800

## 7. MASTER SHEET FOR MUNICIPAL SERVICES DEPARTMENT

### General Characteristics

| | MS1 |
|---|---|
| Land Development | |
| Typical Construction Cost | $3,000,000 |
| Land Requirement | 12% |
| Depreciation and Maintenance | |
| Annual Depreciation Rate | 3.3% |
| BG and BS Requirements | |
| For 1% Renovation or Maintenance | |
| BG | 2 units |
| BS | 1 unit |
| For Normal Operation | |
| BG | 7 units |
| BS | 3 units |

### Design Capacity (MS units) as a Function of Employment Mix

| PL Worker Units | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| PM Worker Units | | | | | | | |
| 0 | | 140 | 230 | 380 | 500 | 680 | 730 |
| 1 | 200 | 330 | 470 | 620 | 740 | 850 | 950 |
| 2 | 400 | 550 | 770 | 860 | 970 | 1,080 | 1,180 |
| 3 | 600 | 780 | 940 | 1,100* | 1,220 | 1,320 | 1,420 |
| 4 | 730 | 970 | 1,170 | 1,300 | 1,400 | 1,500 | 1,590 |
| 5 | 950 | 1,150 | 1,300 | 1,580 | 1,580 | 1,670 | 1,750 |
| 6 | 1,100 | 1,325 | 1,490 | 1,660 | 1,740 | 1,825 | 1,900 |

(Note: There are 16 workers in a PM and 20 workers in a PL.)

*The least cost design capacity of MS1.

### Drain on Municipal Services

| Land Use | Drain of MS Units |
|---|---|
| HI1 | 105 |
| LI1 | 65 |
| NS1 | 50 |

Master Sheet for Municipal Services Department - (continued)

Drain on Municipal Services (continued)

| Land Use | Drain of MS Units |
|---|---|
| BG1 | 25 |
| BS1 | 10 |
| PG1 | 30 |
| PS1 | 10 |
| RA1 | 10 |
| RB1 | 60 |
| RC1 | 250 |

## 8. MASTER SHEET FOR THE HIGHWAY DEPARTMENT

### General Characteristics

| Land Development | HY1 | TM1 |
|---|---|---|
| Typical Construction Costs | $26,600 | $1,400,000 |
| Land Requirements | 8% from 2 sides | 12% from 4 sides |

(Note: Land requirements for HY2 are 12% and for HY3 are 16% (from both sides of roadbed) and for TM2 are 16% and TM3 are 20% (from all four corners).)

| | | |
|---|---|---|
| Depreciation and Maintenance | | |
| Depreciation due to Use | 5.0Z | None |

(Note: Z = actual use/effective capacity; it is not applicable unless Z 0)

| | | |
|---|---|---|
| BG and BS Requirements | | |
| For 1% Renovation or Maintenance | | |
| BG | $233/distance unit (fixed cost) | -- |
| BS | $33/distance unit (fixed cost) | -- |
| Design Capacity | 500 units per distance unit | 10,000 units |
| Road Unit Consumption per Distance Unit | | |
| To Work by Auto | 10 units per population unit | |
| To Work by Bus | | |
| Level 1 | 50 units | |
| Level 2 | 100 units | |
| Level 3 | 150 units | |
| Terminal Unit Consumption by: | | |
| HI1 | | 3000 units |
| LI1 | | 1000 units |
| BG1 | | 1 unit per CU sold |
| Federal-State Aid (for approved construction projects) | | |
| HY1 | $1 for every local $9 | |
| HY3 | $1 for every local $1 | |

## 9. MASTER SHEET FOR PLANNING AND ZONING

### Zoning Classification

| Land Use | Classification |
|---|---|
| Any Use | 00 or -- |
| Any Business | 10 |
| Any Manufacturing | 20 |
| HI | 21 |
| LI | 22 |
| CI | 23 |
| Any Commercial | 30 |
| NS | 31 |
| BG | 32 |
| BS | 33 |
| PG | 34 |
| PS | 35 |
| Any Residential | 40 |
| RA | 41 |
| RB | 42 |
| RC | 43 |

| | |
|---|---|
| Parkland | 50 |

Federal-State Aid is available for purchase of land with the probability that aid will be granted increasing as the amount of the request decreases and existing ratio of population/square mile of parkland increases.

## 10. MASTER SHEET FOR THE UTILITY DEPARTMENT

### General Characteristics

| Level of Service | Installation Costs paid to Outside | Maximum Amount of Utility Units Installed |
|---|---|---|
| Level 1 | 200,000 | 100 |
| Level 2 | 400,000 | 200 |
| Level 3 | 500,000 | 300 |
| Level 4 | 600,000 | 400 |
| Level 5 | 800,000 | 500 |
| Level 6 | 1,100,000 | 600 |
| Level 7 | 1,400,000 | 700 |
| Level 8 | 1,800,000 | 900 |
| Level 9 | 2,800,000 | 1,300 |

### Variable Cost Function of a UT1

| Utility Units Served | Per Unit Operating Costs | Total Operating Costs |
|---|---|---|
| 300 | $2,000 | $600,000 |
| 600 | 1,333 | 800,000 |
| 900 | 963 | 866,666 |
| 1200 | 777 | 933,333 |
| *1500 | *666 | 1,000,000 |
| 1800 | 740 | 1,333,333 |
| 2100 | 793 | 1,666,666 |
| 2200 | 808 | 1,777,777 |
| 2500 | 844 | 2,111,111 |
| 2800 | 873 | 2,444,444 |

*The least cost design capacity of a UT1.

### Utility Units Consumed

| Land Use | Consumption |
|---|---|
| Basic Industries | |
| HI1 | 402 |
| LI1 | 135 |
| NS1 | 76 |
| Commercial Establishments | |
| BG1 | 112 |
| BS1 | 71 |
| PG1 | 99 |
| PS1 | 77 |

Utility Units Consumed (continued)

| Land Use | Consumption |
|---|---|
| Residences | |
| RA1 | 4 |
| RB1 | 26 |
| RC1 | 117 |

Note: Typical price for utility service is $10,000 per unit.
The construction cost of a utiltiy plant is $12,000,000.
Utility plants must be built by the Outside.

## 11. MASTER SHEET FOR BUS COMPANY

### General Characteristics

| | |
|---|---|
| Operating Expenses | |
| Fixed Cost of equipment per distance unit | $13,000 (13 units) |
| Employment | |
| Typical cost of labor per distance unit | 1,300 |
| Units of labor required per distance unit | 16 |

NOTE: Bus hires middle income (PM) workers only. There are 16 workers in a PM. The typical salary per worker is $5,000. One PM supplies 1000 units of labor and 50 units of labor are required to operate a bus (level 1) for one distance unit.

| | |
|---|---|
| Depreciation and maintenance of equipment | |
| Average rate (annual) | 3.5% |
| BG and BS requirements for 1% renovation or maintenance | |
| BG | $4/unit of equipment |
| BS | $6/unit of equipment |
| Passenger Capacity (people) When value ratio = 100 | |
| Level 1 Route | 300 |
| Level 2 Route | 600 |
| Level 3 Route | 900 |

# 12. INPUT EXPLANATION FORMS

CITY MODEL - SMALL SCALE
ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision-Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | A, B, C, etc. | location | price (in $100's) | seller (economic decision-maker or department and jurisdiction or, if bid, OU) | if from department, percent of parcel | |
| Change Rents | $CVPT | A, B, C, etc. | R | location | new rent/PL1 (in $100's) | | |
| Change Prices | $CVPT | A, B, C, etc. | P | location | basic price/CU (in $10's) | | |
| Change Salaries | $CVPT | A, B, C, etc. | S | location | salary to low income (specified as salary per worker in $100's) | salary to middle income (specified as salary per worker in $100's) | salary to high income (specified as salary per worker in $100's) |
| Change Maintenance Level | $CVPT | A, B, C, etc. | M | location | new maintenance level | | |

CITY MODEL - SMALL SCALE. ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision-Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Lend Money | $OTHER | A, B, C, etc. | LO | amount (in $1,000's) | term (2 or 25) | interest rate (in mils) | borrower |
| Borrow Money from the Outside System | $OTHER | A, B, C, etc. | BO | amount (in $1,000's) | term (2 or 25) | | |
| Invest in speculative stocks | $OTHER | A, B, C, etc. | SP | amount (in dollars) | | | |
| Invest in conservative stocks | $OTHER | A, B, C, etc. | CN | amount (in dollars) | | | |
| Sell speculative stocks | $OTHER | A, B, C, etc. | SELLSP | amount (in dollars) | | | |
| Sell conservative stocks | $OTHER | A, B, C, etc. | SELLCN | amount (in dollars) | | | |
| Build, upgrade, or demolish by Outside | $OUBLD | A, B, C, etc. | site location | land use | Old level (0 if new building) | new level (0 if demolition) | maintenance level |
| | | | f | g | h | i | |
| | | | if residence, quality index; if business, salary to low-income worker (in $100's) | if residence, 0; if business, salary to middle-income worker (in 100's) | if residence, rent per PL1 (in $100's); if business, salary to high-income worker (in $100's) | if commercial (BG, BS, PG, PS), price/CU (in $10's) | |

CITY MODEL - SMALL SCALE. ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision-Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Build, upgrade, or demolish by local Construction Industry | $BUILD | CI owner | CI location | contractee (economic decision-maker or department & jurisdiction) | site location | land use (RA, RB, RC, HI, LI, NS, BG, BS, PG, PS, SC, HY, TM, MS) | old level (0, if new building) |

| f | g | h | i | j | k | l |
|---|---|---|---|---|---|---|
| new level (0, if demolition) | agreed price (in $10,000's) | maintenance level unless HY or TM; if HY or TM is on jurisdiction boundaries, list of jurisdictions separated by commas | if residence, quality index; if business salary to low-income worker (in $100's); if SC or MS, number of middle or low-income Pl's employed there | if residence, 0; if business, salary to middle-income worker (in $100's); if SC or MS, number of high or middle-income Pl's working there | if residence rent per PL1 (in $100's) if business, salary to high-income worker (in $100's) | if commercial (BG, BS, PG, PS) price/CU (in $10's) |

CITY MODEL - SMALL SCALE. ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision-Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Transfer cash | $CASH | A, B, C, etc. | C | receiver (economic decision-maker or department and jurisdiction) | amount (in | PVT | if economic decision-maker receiving, PVT; if department receiving, CAPital or CURrent account | |
| Boycott commercial establishments | $BYCT | A, B, C, etc. | E | land use boycotting | S | location boycotted | Stop the boycott or Begin it | |

CITY MODEL - SMALL SCALE
SOCIAL DECISION-MAKERS: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|---|
| Allocate time by jurisdiction, by class | $TIME | AA, BB, CC, etc. | class (H, M, or L) and jurisdiction (1, 2, or 3) | time units in extra work; if none, 0 | time units in public adult education; if none, 0 | time units in adult education; if none, 0 | time units in politics; if none, 0 | time units in recreation; if none, 0 | |
| Allocate time by jurisdiction, by class, by parcel | $TIME | AA, BB, CC, etc. | class (H, M, or L) and jurisdiction (1, 2, or 3) | time units in extra work; if none, 0 | time units in public adult education; if none, 0 | time units in adult education; if none 0 | time units in politics; if none, 0 | time units in recreation; if none 0 | residence location |
| Boycott | $BYCT | AA, BB, CC, etc. | S | class boycotting (H, M, or L) | function boycotted (Shop or Work) | location boycotted (0 if department) | Stop the boycott or Begin it | if applicable, department (SC, MS) and jurisdiction (1, 2, or 3) | |
| Change | $VALUE | AA, BB, CC, etc. | class (H, M, or L) | dollar value of time unit travelling | | | | | |

CITY MODEL -- SMALL SCALE
CHAIRMAN & COUNCIL: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Grant Capital Appropriations | $CASH | CH1, CH2 or CH3 | CP | department receiving and juris-diction | amount (in dollars) | | |
| Grant Current Appropriations | $CASH | CH1, CH2 or CH3 | CR | department receiving and juris-diction | amount (in dollars) | | |
| Grant Current Subsidy | $CASH | CH1, CH2 or CH3 | CURS | department receiving and juris-jurisdiction | amount | | |
| Grant Capital Subsidy | $CASH | CH1, CH2 or CH3 | CAPS | department receiving and juris-diction | amount (in dollars) | | |
| Transfer Cash | $CASH | CH1, CH2 or CH3 | C | receiver (economic decision-maker or department and juris-diction | amount (in dollars) | CUR | if economic decision-maker receiving, PVT if department receiving, to CAPital or CURrent account |

CITY MODEL - SMALL SCALE. CHAIRMAN & COUNCIL: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Grant Subsidy to Economic Decision-Maker | $CASH | CH1, CH2 or CH3 | SB | receiver | amount (in dollars) | | |
| Set Welfare Payments | $OTHER | CH1, CH2 or CH3 | W | amount per unemployed worker (in $100's) | | | |
| Change land tax rate | $TAXES | CH1, CH2 or CH3 | L | land tax rate (in mils) | | | |
| Change development tax rate | $TAXES | CH1, CH2 or CH3 | D | development rate (in mils) | | | |
| Change resident (or employee) | $TAXES | CH1, CH2 or CH3 | RI (or EI) | resident (or employee) income (in mils) | | | |
| Change resident (or employee) | $TAXES | CH1, CH2 or CH3 | RA (or EA) | resident (or employee auto expenses (in mils) | | | |

CITY MODEL - SMALL SCALE. CHAIRMAN & COUNCIL: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Change goods sales tax rate | $TAXES | CH1, CH2 or CH3 | G | goods tax rate (in mils) | | | |
| Change services sales tax rate | $taxes | CH1, CH2 or CH3 | S | services tax rate (in mils) | | | |
| Float Capital Bonds | $OTHER | department receiving and jurisdiction | BO | amount (in $1,000's) | 25 | | |

CITY MODEL -- SMALL SCALE
ASSESSMENT DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Decision Code | Decision Maker | a | b | c |
|---|---|---|---|---|---|
| Change Development Change Rates for all land uses jurisdiction-wide | $ASMNT | AS1, AS2 or AS3 | D | Development Assessment Rate in tenths of of a percent (i.e., "500" equals "50%") | |
| Change Development Assessment Rate for a particular land use | $ASMNT | AS1, AS2 or AS3 | D & land use code (i.e., DH1 DLI, DNS, DCF, DBG, DBS, DPG, DPS, DRA, DRB, or DRC) | Development Assessment Rate in tenths of a percent (i.e., "500" equals "50%") | |
| Change Land Assessment Rate Jurisdiction-wide | $ASMNT | AS1, AS2 or AS3 | L | Land Assessment Rate in tenths of a percent (i.e., "500" equals "50%") | |

CITY MODEL - SMALL SCALE. ASSESSMENT DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Decision Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Change Land Assessment Rate for parcels with a particular land use | $ASMNT | AS1, AS2 AS3 | L and land use code (i.e. LHI, LLI, LNS, LCI, LBG, LPS, LRA, LRB, LRC, or LUL) 1/ | Land Assessment Rate in tenths of a percent "500" equals "50%") | | | |
| Define Special Zones 2/ | $ASMNT | AS1, AS2 or AS3 | SZ | zone number (1,2, 3, 4, etc.) | list of upper left and lower right inter-sections coordinates 3/ | | if any other special zone is to have same special rates as this, zone number here |
| Change Develop-ment or Land Assessment Rates within a Special Zone | $ASMNT | AS1, AS2 or AS3 | Develop-ment or Land | Land or Develop-ment Assess-ment Rate in tenths of a percent (i.e., "500" equals "50%") | Zone Number | | |

1/ "UL" is the land use code for undeveloped land.
2/ No special zones are carried from one round to the next, they must be redefined each round before any special rates by zone are initiated.
3/ Intersection coordinates are odd-numbered. Thus "9125, 9933" would include all parcels in the rectangle formed by parcel 9226 in the upper left hand corner and parcel 9832 in the lower right hand corner.

CITY MODEL - SMALL SCALE. ASSESSMENT DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Decision Code | Decision Maker | a | b | c | d |
|---|---|---|---|---|---|---|
| Change of Development Assessment Rate for a particular land use or change Land Assessment rate for parcels with a particular land use within a special zone | $ASMNT | AS1, AS2 or AS3 | Development or Land and land use code (i.e., DHI, DLI, or LHI, LLI, etc.) | Land or Development Assessment Rate in tenths of a percent (i.e., "500" equals "50%") | Zone number | |
| Make Special Assessments for land and developments | $ASMNT | AS1, AS2 or AS3 | SA | Location | Assessed value of land (in $10,000's) | Assessed value of Developments (in $10,000's) |

Note: After all assessment decisions are made, write "ASMNT/#AS1, 2 or 3/END" on the last line of the input decision form.

CITY MODEL -- SMALL SCALE
SCHOOL DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | SC1, SC2, or SC3 | location | price (in $100's) | seller (economic decision-maker or department) | percent of parcel (0 if all) | | |
| Change employ-ment | $CVPT | SC1, SC2, or SC3 | E | location | new number of PM units working there | new number of PH units working there | | |
| Change mainten-ance level | $CVPT | SC1, SC2, SC3 | M | location | new maintenance level | | | |
| Change district boundaries | $REDIST | SC1, SC2, or SC3 | location of school | list of new parcels in district in parentheses* | | | | |

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by " > ". Example:

$REDIST/=SC1/9232 > 10040)

CITY MODEL - SMALL SCALE. SCHOOL DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Request Federal-State aid | $FSA | SC1, SC2, or SC3 | new level of school for which aid is requested (1, 2, or 3) | location | | | | |
| Change salaries | $OTHER | SC1, SC2, or SC3 | S | salary to middle income worker (in $100's) | salary to high income worker (in ($100's) | | | |

| | | | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|---|
| Construct, upgrade or demolish a school by the "Outside System" | $OUBLD | SC1, SC2, or SC3 | site location | SC | old level (0, if new building) | new level (0, if demolition | new maintenance level | number of PM's working | number of PH's working there |

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| Construct, upgrade or demolish a school by the local Construction Industry | (See CI owner) | | | | | |

CITY MODEL -- SMALL SCALE
MUNICIPAL SERVICES DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | MS1, MS2, or MS3 | location | price (in 100's) | seller (economic decision-maker or department and jurisdiction or OU) | percent parcel (0 if all) | |
| Change employment | $CVPT | MS1, MS2, or MS3 | E | location of plant | new number of PL's working there | new number of PM's working there | |
| Change maintenance level | $CVPT | MS1, MS2, or MS3 | M | location of plant | new maintenance level | | |
| Change district boundaries | $REDIST | MS1, MS2, or MS3 | location of MS plant | list of new parcels in parentheses* | | | |

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by " > ". Example:

$REDIST/=MS/9230, (9232 > 10040)

CITY MODEL -- SMALL SCALE. MUNICIPAL SERVICES DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Award BG or BS contracts | $CVPT | MS1, MS2, MS3 | C | location of BG or BS establishment | percent of total BG or BS purchase to be bought there | new priority | displaced priority | owner |
| Change salaries | $OTHER | MS1, MS, or MS3 | S | new salary to low-income worker (in $100's) | new salary to middle-income worker (in $100's) | | | |

| | | | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|---|
| Construct, upgrade or demolish an MS plant in the "Outside System" | $OUBLD | MS1, MS2, or MS3 | site | MS | old level (0 if new building) | new level (0 if demolition) | maintenance level | new number of PL's working there | new number of PM's working there |

CITY MODEL -- SMALL SCALE. MUNICIPAL SERVICES DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|---|
| Construct, upgrade or demolish MS plant by a local Construction Industry | | | (see CI owner) | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 218 | Transfer cash | $CASH | MS1, MS2, or MS3 | C | receiver (economic decision-maker or department and jurisdiction) | amount (in dollars) | from CAPital or CURrent account | if economic decision-maker receiving, PVT; if department receiving, to CAPital or CURrent account |

CITY MODEL -- SMALL SCALE
HIGHWAY DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | HY1, HY2, or HY3 | location | price (in ($100's) | seller economic decision-maker or department and jurisdiction or OU) | percent of parcel (0 if all) | |
| Change Maintenance Level | $OTHER | HY1, HY2, or HY3 | M | new maintenance level | type of road (1, 2, or 3) | | |
| Construct, upgrade or demolish a road or terminal by the "Outside System" | $OUBLD | HY1, HY2, or HY3 | site location | HY if road TM if terminal | old level (0 if new road or terminal) | new level (0 if demolition) | if on jurisdiction, boundary jurisdiction numbers, separated by commas |
| Construct, upgrade or demolish a road or terminal by the local construction industry | (See CI owner) | | | | | | |
| Request Federal-State aid | $FSA | HY1, HY2, or HY3 | new level for which aid requested (1, 2, or 3) | list of coordinates of end intersections of straight road sections in parentheses (e.g., $FSA/=HY1/2, (9927, 9931, 9931, 8731) | | | |

CITY MODEL -- SMALL SCALE. HIGHWAY DEPARTMENT: INPUT EXPLANATION FORM -- continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Transfer Case | $CASH | HY1, HY2, or HY3 | C | receiver (economic decision-maker or department and jurisdiction) | amount (in dollars) | from CAPital or CURrent account | if economic decision-maker is receiving, PVT; if department is receiving, to CAPital or CURrent account |

CITY MODEL -- SMALL SCALE
PLANNING AND ZONING DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | PZ1, PZ2, or PZ3 | location | price (in $100's) | seller (economic decision-maker or department & jurisdiction or OU) | percent of parcel (0 if all) | |
| Change | $CVPT | PZ1, PZ2, or PZ3 | Z | location | new zoning code | | |
| Request | $FSA | PZ1, PZ2, or PZ3 | amount (in $100's) | (maximum three requests) | | | |
| Transfer cash | $CASH | PZ1, PZ2, or PZ3 | C | receiver (economic decision-maker or department and jurisdiction) | amount (in dollars) | CAP | if economic decision-maker is receiving, PVT if department is receiving, to CAPital or CURrent account |
| Create public institutional land use | $CVPT | PZ1, PZ2, or PZ3 | PI | location | percent to be added to public institutional | | |
| Demolish public institutional land use | $CVPT | PZ1, PZ2, or PZ3 | RPI | location | percent to be subtracted from public institutional | | |

CITY MODEL -- SMALL SCALE
UTILITY DEPARTMENT: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Purchase or bid on land | $PU | UT1, UT2, or UT3 | location | price (in $100's) | seller (economic decision-maker or department or OU) | percent of parcel (0 if all) | |
| Change utility service | $CVPT | UT1, UT2, or UT3 | US | location | location of plant serving | new level of service | |
| Change prices | $OTHER | UT1, UT2, or UT3 | P | new price per unit of utility service | | | |
| Construct, upgrade or demolish a utility plant | $OUBLD | UT1, UT2, or UT3 | site location | UT | old level (0 if new plant) | new level (0 if demolition) | |
| Transfer cash | $CASH | UT1, UT2, or UT3 | C | receiver (economic decision maker or department and jurisdiction) | amount (in dollars) | from CAPital or CURrent account | if economic decision maker receiving, PVT; if department receiving, to CAPital or CURrent account |

CITY MODEL -- SMALL SCALE
BUS COMPANY: INPUT EXPLANATION FORM

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Change routes or level of service | $ROUT | BUS | route number | old level of service | new level of service (0 if elimin-route) | list, in parentheses, of intersections in order, where bus starts, turns and finishes (0 if no changes to route location | 0 |
| Transfer cash | $CASH | BUS | C | receiver (economic decision maker or department and juris-diction) | amount (in dollars) | from CAPital or CURrent account | if economic decision-maker receiving, PVT if department receiving, to CAPital or CURrent account |
| Purchase Rolling Stock | $OTHER | BUS | PS | number of units of equipment | | | |
| Sell Rolling Stock | $OTHER | BUS | SS | number of units of equipment | | | |

CITY MODEL -- SMALL SCALE. BUS COMPANY: INPUT EXPLANATION FORM continued

| Type of Decision | Code | Decision Maker | a | b | c | d | e |
|---|---|---|---|---|---|---|---|
| Set fares | $OTHER | BUS | P | base fare per worker, per journey (in ¢) | 0 | price per mile (in ¢) | |
| Change salaries | $OTHER | BUS | S | new salary to PM worker (specified as salary per worker in $100's) | | | |
| Change maintenance | $OTHER | BUS | M | new maintenance level | | | |

# APPENDIX L

## DESIGNING A NEW STARTING POINT (LOAD)

## TO THE CITY MODEL

APPENDIX L: Designing a New Starting Point (Load) to the City Model

Two approaches can be taken in designing a new starting load. One is to base the design using existing data for an actual city covering as many parameters as possible. The other is to base the design on some specific combination of situations which may or may not be represented by any particulat city. The main difference lies in the search for data necessary in the former, as the sequence of steps remain the same either way.

This description will begin with a discussion of the non-real data approach and follow that with a discussion pointing out the differences involved in fitting real data to the load.

Steps in Designing

First, the list below outlines and suggests an order to be taken in designing a new starting load and will be followed by a more detailed description of each step.

First Phase

1. Decide on the target population (not more than 3 million large scale and 300 thousand small scale).

2. Determine the number of employers of each type of business.

3. Determine the breakdown of total population into the three income class components.

4. Determine an initial unemployment rate per income class.

5. Decide on the general layout of the city (or cities).

6. Determine the number of residence units of each type.

7. Locate the terminals, businesses and residences on the board.

8. Place population units in the residences.

9. Decide on the number of public facilities and public unused land.

10. Locate all municipal land uses and preempt land.

11. Specify all bus and rail routes.

12. Specify all municipal service, school, utility and ward districts.

13. Assign economic decision-makers.

14. Assign social decision-makers.

Second Phase

15. Assign quality indices and value ratios.

16. Specify rents, salaries and prices.

17. Assign education levels.

18. Specify zoning.

19. Specify time allocation.

20. Specify the initial amount of cash and bonding for each economic team.

21. Specify the dollar value of time.

Third Phase

22. Specify municipal department salaries, initial bonding and appropriations.

23. Specify tax rates and assessment ratios.

24. Specify BG/BS contracts of various government departments, boycotts and the welfare subsidy.

Steps Explained

1. Deciding on the target population is merely a matter of personal preference. Then convert this target figure into an equivalent number of population units.* The precise target figure may not be the final figure as adjustments often occur in subsequent steps.

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*In a normal scale city, a Pl is equivalent to 500 people, and in a small city Pl is equivalent to 50 people.

2. Determining the number of employers should be done by choosing a desired mix of levels of HI's, LI's, and NS's so that their summed employment requests in population units is about 50% of the target population in population units. Then, as a first approximation, add one level each of a BG, PG, and PS for each 250,000 people and one level of a BS for each 350,000 people. A rule of thumb for the construction industry is to choose one level of CI for up to 400,000 people, two levels of CI's for 400,000 - 1,000,000 people and three levels of CI's for 1,000,000 and over.

The number of levels of SC can be approximated by estimating the total number of students. Assuming a 35-35-30 percentage breakdown among high, middle, and low income population units and a ratio of 130, 140 and 100 student per high, middle and low income population unit, the number of schools is obtained by dividing the number of students by the average number of students per school desired.

Example:

Given: 200 population units - 3000 students/SC1

Approximately
- 70 high income units (35%)
- 70 middle income units (35%)
- 60 low income units (30%)

Yielding:
- 9100 high income students (70 x 130)
- 9170 middle income students (70 x 140)
- 6000 low income students (60 x 100)

24270 students

Therefore $\frac{24270 \text{ students}}{3000 \text{ students/SC1}}$ = 8 levels of school

Assume the same number of levels of MS's as number of levels of SC's.

With the list of employer types, calculate the total employment request in terms of population units. If this calculated figure understates the target figure by more than 2.5%, then adjustments need to be made. Disagreement between the two figures can be remedied by adding or subtracting one or more levels of business of the desired type(s) until a match is attained.

Determining the breakdown of total population into the three income class components is accomplished by considering the employee requests of each employer, business and public, by income class. The resulting figure for each income class is the employed number of population units for that class.

---

Levels of development of each business activity can be represented in CITY MODEL either by individual level one developments (e.g., 6, HI1's) or aggregations of levels onto fewer developed parcels (e.g., 2 HI3's).

4. Determining an initial unemployment rate per income class, which can be real world figure or of the designer's creation, translates into the number of population units for each class and yields the total population in each class when considered in conjunction with #3 above.

5. Deciding on the general layout of the city (or cities) involves several separate tasks. Locational determinants such as terminals and roads must be placed on the board, at least in a general fashion, and the approximate specified. The type of land use pattern, whether concentrated or spread out must be decided upon as well as the general pattern of population distribution by class throughout the area. The general shape of the city (or cities) should be considered in conjunction with the road pattern: a long, narrow shape with one main road, several principal corridors radiating outward from the center, or a circular ring idea are all possibilities. Finally, locate the businesses on the board in at least a preliminary fashion.

6. Determining the number of residence units of each type must be accomplished before they can be located on the board and the final form of the city is established. Initially assume that all residence units are of type RA. Since the total number of population units in each class is known from #3 and #4, the high income class population units are equivalents of the low and middle income population units for residence placement purposes. Under uncrowded circumstances, two low income population units, one high income population unit, or one and one-half middle income population units will live in an RA1. Therefore, the high income class population unit equivalent is one half the low income population unit and the middle income population units equivalent is three-fourths, or a division of 2 and 1.5 into the high income population equivalent respectively.

Next, one adds the low and middle equivalents to the number of actual high income population units to arrive at one number; call it A. This number is also the number of levels of RA's needed if there are to be no net vacancies or no net overcrowding. To the extent that net vacancies are desured, then the number of levels or RA's needed will be A + V where V is the number of net high income class equivalent population unit vacancies. $\frac{V}{A + V}$ is the vacancy rate.

The last step, considering that an RB1 is equivalent to six RA1's and an RC1 is equivalent to 25 RA1's, is to convert as many RA's as desired into RB's and RC's until one arrives at the desired mix among RA's, RB's, and RC's.

Example:

Given: 70 high income population units (PH)
60 middle income population units (PM)
30 low income population units (PL)

Coversion to PH;

$$70 \text{ PH} = 70 \text{ PH}$$

$$60 \text{ PM} = 60 \text{ PM} \div \frac{1.5 \text{ PM}}{\text{PH}} = 40 \text{ PH}$$

$$30 \text{ PL} = 30 \text{ PL} \div \frac{2 \text{ PL}}{\text{PH}} = 15 \text{ PH}$$

Total = 125 PH

Vacancies desired:

$$V = 5 \text{ PH units}$$

$$\frac{V}{A + V} = \frac{5}{130} = 3.8\% \text{ vacancy rate}$$

Mix of RA, RB and RC:

1 RA = 1 RA
= 6 RB
= 25 RC

Therefore, a possible mix is:

20 RA = 20 RA
10 RB = 60 RA
2 RC = 50 RA
—
130 RA for 130 PH equivalents

7. Locating the terminals, businesses and residences on the board can then be done according to the general layout in #5 and the designer decides where the more dense housing should be located (RC's and to a lesser extent RB's), and where the intensive versus the sparse residential development should be located (many residential units on a parcel versus few such units, independent of residence type). Most likely, the dense

and intense development will occur near the center of employment and shopping, but some designers may have other preferences.

8. Placing population units in a residence is also done on the basis of the general pattern determined in #5 above. The residence units on some parcels may be intentionally overcrowded while others will have vacancies. Using the fact 1 PH = 1.5 PM = 2 PL for purposes of residential space consumption and the constraint that PH's and PL's will not live in the same residential complex (the same parcel), the designer should place population units in residences until all are located. Then a re-calibration process will probably be necessary to adjust many of the vacancy rates, by marginally relocating a few population units.

9. Establishing the number of utility plants will complete the number of public facilities at this point, as this has already been done for schools and municipal services in #2.

10. Locating all municipal land uses and preempt land can then be accomplished. This involves location of schools, municipal services plants, utility plants, parkland and public institutional (developed parkland); the precise specification of roads, also assuring that all parcels have road access to all other parcels by however circuitous a route; the precise location of surface rail lines and the location of preempt land. If the designer so desires, he may also allocate vacant land to some or all departments.*

11. Specifying all bus and rail routes follows because the highway and rail systems are now known, and the centers of concentration of trip origins and destinations can be estimated from the placement of population units and location of businesses.

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*Note: When locating private or public land uses as in $5, #7 and #9, the designer should continually be aware of the amount of available land remaining after a particular land use has been located so that not more than 100% of any parcel is consumed.

12. Specifying all municipal services, school, utility (and, if desired, ward) districts can be done here. When the general layout of the city was determined, the areas of good and poor public services were also in general, delineated. The designer should: Calculate the number of students requiring education from each parcel and the municipal and utility drains of each parcel; define the districts; taking into account the general layout of #5, the level of the particular public facility, and thereby as approximation of its capacity, and the demands originating from each parcel, and as a final tuning procedure for schools and municipal services plants, set the employment mix to indicate an exact figure for capacity, student-teacher ratio and ratio of high-to-middle income teachers. As for wards, they can be gerrymandered in any way desired, or specified on some other rational basis, but are only useful if a city council will be used during the play of the game.

13. Assigning economic decision-makers to the desired parcels can be done in any of a number of ways. One should first specify the number of economic decision-makers (and thereby the number of social decision-makers as well). Among the approaches are: entirely random assignments to assure an even mix of holdings on the part of each economic team, and start out each economic team with different specialized interests. Only the designer's imagination limits the number of possibilities.

14. Assigning one of the three income classes on a particular parce to a social decision-maker is done so that if a population of any class moves to any parcel on the baord, there will be a specific social decision-maker who controls it. Social decision-makers are assigned to every parcel for all three income classes.

This can be done in any one of many ways, as in #13 above. It is usually advisable to assure that any one social decision-maker controls population units from no more than two different income classes because it becomes impossible for him to define his identity if he must be concerned with the interests of all three income classes. Further, some social sector teams should have only one income class under their control.

Second Phase

15. Assigning Quality Indexes to all the residences and Value Ratios to all the businesses and public structures (where applicable) is the first step in the second phase of starting position design. For business and

public structures, the Value Ratio is an indication of physical efficiency and state of repair or maintenance on a scale from 0 to 100. Those enterprises deemed efficient or new would have value ratios close to 100 and those deemed inefficient and dilapidated would have lower value ratios. The Quality Index refers to housing and indicates the cost of construction and the "classiness" of the housing unit. A Quality Index of 35 does not mean bad housing, merely low income housing. Thus, quality indices are assigned according to the resident income classes.

16. Specifying rents, salaries and prices must be done for each residence parcel (rents), each business (salaries) and each commercial enterprise (prices). These values are set at or near the typical values; or above or below depending on the class of resident, the Quality Index, the section of town for rents; and, similarly, the Value Ratio and location for prices and salaries.

17. Assigning education levels to all the residential parcels for each income class that is initially resident there involves assigning the highest education levels (within a given class) to the population units on the parcels which the designer feels would have the highest skill levels and be the more desirable employees.

18. Specifying the zoning for all parcels where desirable, can be done at any point after all private land uses have been located. Some parcels may be zoned differently than the existing land use to show some non-conforming land uses. Some undeveloped parcels may also be zoned in order to limit the type of development on the fringe, or give impetus to certain types of developments.

19. Specifying the time allocation for each social decision-maker by income class. The designer may use any of the existing theories on the way people in different income classes spend their leisure time, as this relates to the four categories in the CITY MODEL: part-time work, adult education, political activity and recreation. For instance, the designer might feel that low income people tend to place more emphasis on an extra job, while middle income individuals would emphasize adult education and the high income class, political activity or recreation. However, this is only one possible approach of many.

20. Specifying the initial amount of cash and bonding for each economic team should depend on the purposes of the group(s) that will play the CITY MODEL. For longer plays or classroom use, a more realistic cash and bonding structure should be specified. That is, no team should have over $100,000,000 in cash ($10,000,000 if the smaller scale is intended). For areas with a population of around 400,000 (or 40,000), the median cash holding might be $30,000,000 (or $3,000,000) while for an area with a population of 1,000,000 or more (in large scale city only), the median might be around $50,000,000. If, on the other hand, shorter plays are intended, a more developmental approach would probably be desirable. In such a situation higher starting cash holdings might be desirable.

In either case, realistic bond holdings should be specified. A rule of thumb might be that outstanding debt should equal between forty and fifty percent of an economic team's real assets (land plus developments). The debt should, of course, be a long term of about 20 years.

21. Specifying the dollar value of time of each class of population unit for each social decision-maker should be done with several things in mind. One is that the dollar value of time is the mechanism by which population units trade-off more time consuming but lower cost public transit with quicker but more expensive private automobile travel. Another is that high income population units tend to have higher values than middle income and so on.

Third Phase

22. Specifying municipal department salaries, initial bonding and appropriations is the first step of the third and last phase in designing a starting point. Department salaries should be set in relation to the intended fiscal soundness of the municipal government and the qulaity of service of the particular department. Initial bonding can be a rather arbitrary specification, the important thing being that each department have some bonded indebtedness. The best way to approach appropriations is to set them at zero initially, obtain a round zero output with all the other load specifications and from the departmental outputs determine how much appropriations are needed.

23. Specifying tax rates and assessment ratios go hand in hand. For the property tax higher assessment ratios permit lower tax rates and vice versa in order to obtain a given revenue. For other taxes, there is no control over the tax base only the rate. The base for these taxes is determined entirely within the model. The designer has a wide variety of taxes from which to choose for his intital configuration and is encouraged to use imagination in the combination upon which he decides.

24. Specifying BG/BS (business goods/business services) contracts of the Municipal Services and School Departments by jurisdiction, boycotts and the welfare subsidy, complete the load specifications. If the Municipal Services or School Department do not have a contract with a local BG and BS firm(s) specified in the load, they will buy all the goods and services they require from the outside system. However, as play begins, these departments can change or make their own contracts.

It is usually fruitful to start the play with boycotts if there is a reason initially designed in the starting city, i.e., very low salaries or very high prices at a particular business. The welfare subsidy should be set at some figure below $2500 (the typical low income class salary), the specific amount depending on a number of factors including municipal revenues and extent of unemployment.

## Loading Real-World Data

The previous discussion has treated the load design when no intent was made to represent an actual urban (or rural) area. In the case where real-world data will be used as the basis for the load, a great deal of data collection and manipulation is necessary as well as some reordering of the 24 steps described above.

1. The designer is given a target population -- the actual population of the area to be simulated.

2. From a census of manufacturing and a census of business for the area in question, derive the employment in each two-digit SIC cateogry. These two-digit categories can then be aggregated into the business types as they exist in the model* -- heavy industry, light industry, national service, business goods, business services, personal goods, personal services, and construction. Some discretion must be exercised in this aggregation process because there are some SIC categories which do not fit conveniently into one of the CITY MODEL business categories. For such SIC categories, their employment figures must be arbitrarily partitioned with a portion allocated to each relevant CITY MODEL category. After all the employment of the area under consideration has been allocated by dividing the eight figures arrived at above by the number of employees per level one of each business type. For instance, if the metropolitan region under consideration had 16,000 workers in light industry type employment (an LI1 employs 5760 full-time workers), 16,000 divided by 5760 equals 2.783. Thus, three levels of light industry should be loaded. Rounding is necessary and the final sum of the employment requests for each of the eight business types should be as close to the actual total employment figure as possible.

3. Using the census of population, derive the breakdown of area population into the three income class cateogries. The income intervals are $0 - $3999 for low-income, $4000 - $6999 for middle income and $7000 - above for high income. These three population figures should then be converted in their population unit equivalents.

4. Add more population units, distributed among the three classes, to account for the unemployed people in the area, using the actual rate of unemployment as the guide.

5 - 8. Use any land use and population density data available, particularly in map form, and census of population and housing data for the breakdown of area housing among the three types.

9. Same.

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*See Appendix J.

10. If no better data is available, use detailed road map.

11. Municipalities will have maps showing all bus and rail routes.

12. Make municipal service and school districts correspond as much as possible to the actual neighborhoods, as well as can be determined. Wards, if they exist, are defined and can be obtained from a political party representative.

13 - 14. Same

15 - 17. The designer may have to depend on a feel of the area for these values, as only general outlines of higher or lower than average may be available.

18. There are zoning maps available, but the codes usually do not coincide with the CITY MODEL codes. Zoning is often plot by plot so that the square mile grid (except for the small scale city) makes transferrance very difficult. Zone intuitively.

19. It is doubtful that there will be any data for such specifications.

20. The designer can use his ingenuity to find some source of data which might help in specifying the overall private liquid reserves and indebtedness of the particular area. If not, use intuition again.

21. There are studies relating to this matter, but only in general not for a particular area.

22 - 23. Data is available at the municipal government.

24. Same

Note: An attempt should be made to insure that the data used is dated on or about 1960 as all of the CITY MODEL parameters are based on the 1960 Census. Considerable inequities would result if current municipal salaries were used, for example.

# APPENDIX M

## FORMATS FOR LOADING A DATA BASE

APPENDIX M: Formats for Loading a Data Base

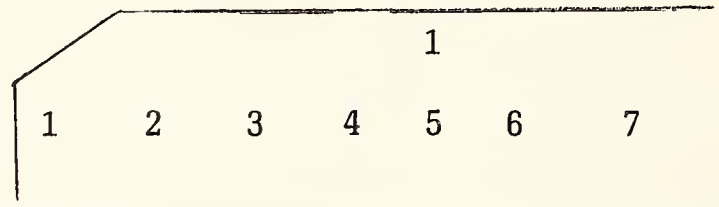
The load program sets up the initial data base for the model's data files. Various city configurations can be created with the initial data set-up. Specifying all the information required for a city description can be lengthy and involved. Particular attention should be paid to the order of the cards and the card field descriptions. The following points should be noted:

1. All data is right justified within a field. Data fills the extreme right hand column of a field and all necessary columns to the left. Any blank columns in a field will be to the left of the data.

Example:

| Cols | Description |
|---|---|
| 1-5 | '1' if outflow point |

Card




2. Card groups are numbered in the order they loaded. That order is the same as the order in which they re processed.

3. Where a card group is of variable length, a blank card ends the group.

4. When there is no information to enter for a card category, insert a blank card.

5. If no number or character is punched, the program will read that column as '0' (zero).

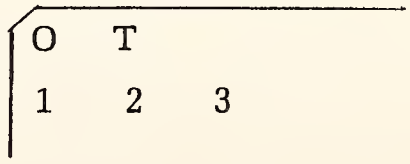
6. If there are no instructions for a column or columns, leave them blank.

7. When information in the load format description appears between apostrophes in a description, punch that specific information on the card.

Example:

| Cols | Description |
|---|---|
| 1-2 | 'UT' |

Card



8. If a column number is followed by an asterisk (*) in the following format description, then the information in those columns for that Card Group cannot be changed after a data base has been loaded.

| Card Group | Cols | Descriptions |
|---|---|---|
| 1 District Cards | 1 | Code for function being districted<br>1-jurisdiction* 5-ward*<br>2-school 6-river basin*<br>3-municipal service 7-flood susceptibility<br>4-utility |
| | 9-10 | District number for associated parcels |
| | 11-18 | Up to 7 pairs of diagonally opposite parcel locations which define a rectangle to be assigned that district number. Either pair of corners in any order may be given. If only one location is given, that parcel is assigned the district number. |
| | ********** | Blank Card ********** |
| 2 Number of Social Decision-Makers | 1-2* | Number of social decision-maker teams |
| 3a Option Cards | * | (See "notes on the Load Program.) |
| 3b Round Number & Headings | 1-5* | Round number (should start at 0) |
| | 6-77 | Game heading for print-out (any alpha-numeric characters) |
| 4 Active Jurisdictions | 1* | Put a 1 if jurisdiction 1 is in existence |
| | 2* | Put a 1 if jurisdiction 2 is in existence |
| | 3* | Put a 1 if jurisdiction 3 is in existence |
| 5 Social Decision-Makers | 1-5<br>6-10 | Pair of diagonally opposite parcel locations defining a rectangular area of control;<br>Cols. 1-5 contain the upper left hand corner<br>Cols. 6-10 contain the lower right hand corner. |

| Card Group | Cols | Descriptions |
|---|---|---|
| 5 Social Decision-Makers | 11-12 | Team letter of social team controlling high income residents on the parcels |
| | 13-14 | Team letter of controlling team for middle income |
| | 15-16 | Team letter of controlling team for low income |
| **********Blank Card********** | | |
| 6 Land Parcel Cards | 1-5 | Parcel coordinate location |
| | 7-8 | Team letter of owner |
| | 10-11 | Two-letter economic activity code (0=undeveloped) |
| | 12-14 | Constructed level of economic activity |
| | 15-17 | Zoning |
| | 18-21 | Value ratio or quality index |
| | 22-25 | Maintenance level |
| | 30-33 | Number of PH's residing on parcel |
| | 34-36 | Number of PM's residing on parcel |
| | 37-39 | Number of PL's residing on parcel<br>There can be at most two income classes on a parcel. PH's and PL's may not be on the same parcel. |
| | 40-43 | Salary offered PH's/$100 if non-residential or rent per space unit if residential |
| | 44-46 | Salary offered PM's/$100 if non-residential or rent per space unit if residential |
| | 47-49 | Salary offered PL's/$100 if non-residential |
| | 54-56 | Level of utilities installed |
| | 60-67 | Price/CU in $100 if commercial establishment |
| | 68-75 | Assessed Value of land/$100,000 for 100 percent of parcel |

| Card Group | Cols | Descriptions |
|---|---|---|
| 6 Land Parcel Cards | 77-78 | If basic industry on parcel, two-letter code for effluent treatment type |
| | 80 | Treatment plant level |
| | **********Blank Card********** | |
| 7 Time Allocations | 1-2 | Team letter of social decision-maker |
| | 4 | Social class (1-low; 2-middle; 3-high) Time allocation percents for: |
| | 6-8 | Part-time work |
| | 9-11 | Public education |
| | 12-14 | Politics |
| | 15-17 | Recreation |
| | 18-20 | Pay Education |
| | **********Blank Card********** | |
| 8 Utility Cards | 1-2 | 'UT' |
| | 3 | Jurisdiction number |
| | 11-15 | Parcel location of plant (0 if no plant, only undeveloped land) |
| | 16-17 | Level of plant (0 if no plant, only undeveloped land) |
| | 18-20 | Percent of parcel (developed plus undeveloped) owned by the Utility Department |

Repeat format as in (11-20) for up to 6 more plants in cols. (21-30), (31-40), (41-50), (51-60), (61-70), (71-80). Use as many cards as required to designate all plants in all jurisdictions. NOTE: Utility land for only one jurisdiction can appear on a single card.

| Card Group | Cols | Description |
|---|---|---|
| 9 School Cards | 1-2 | 'SC' |
| | 3 | Jurisdiction number |
| | 11-15 | Parcel location of School |
| | 16-17 | Level of school (0 if no school, only undeveloped land) |
| | 18-20 | Percent owned by department (developed plus undeveloped) |
| | 21-23 | Value ratio |
| | 24-26 | Maintenance level |
| | 27-29 | Number of PM teachers requested in (Pl's) |
| | 30-32 | Number of PH teachers requested (in Pl's) |

Repeat format as in (11-32) for up to 2 more schools in Cols. (33-54) and (55-76).
NOTE: School land for only one jurisdiction can appear on a single card.

**********Blank Card**********

| | | |
|---|---|---|
| 10 Terminal Cards | 1-2 | 'TM' |
| | 3 | jurisdiction |
| | 11-15 | intersection coordinate |
| | 16-17 | level of terminal |
| | 18-20 | percent of land used by terminal on each of the four parcels surrounding the intersection |

Repeat format as in (11-20) for up to 6 more terminals in Cols (21-30), (31-40) .... (71-80).

**********Blank Card**********

| | | |
|---|---|---|
| 11 Park and Public Institutional Land | 1-2 | 'PZ; or 'PI' |
| | 3 | jurisdiction |
| | 11-15 | parcel containing parkland |

| Card Group | Cols | Description |
|---|---|---|
| | 16-20 | Percent of land in park or public institutional use. |

Repeat format as in (11-20) for up to 6 more parcels in Cols. (21-30) ... (71-80). Land for park use and land for public institutional use cannot be included on the same card. Park or PI land for only one jurisdiction can appear on a single card.

| | | |
|---|---|---|
| 12 Municipal Services | 1-2 | 'MS' |
| | 3 | jurisdiction |
| | 11-15 | parcel location of plant |
| | 16-17 | level of plant (0 if no MS, only undeveloped land) |
| | 18-20 | Percent of land owned by department (developed plus undeveloped) |
| | 21-23 | value ratio |
| | 24-26 | maintenance level |
| | 27-29 | number of PL workers requested (in Pl's) |
| | 30-32 | number of PM workers requested (in Pl's) |

Repeat format as in (11-32) for up to 2 more plants in cols. (33-54) and (55-76). NOTE: MS land for only one jurisdiction can appear on a single card.

**********Blank Card**********

Only one of the two following road card formats may be used in a single load deck. Which of the two is to be used is determined by the Option Card (Card Group 3a) for road formats. The first format allows road value ratios to be different for individual road segments. The second does not have this provision for differentiation but simplifies the coding and punching required for loading roads.

| | | |
|---|---|---|
| 13a Road Cards | 1-2 | 'RD' |
| | 3 | jurisdiction |
| | 11-15 | intersection where road segment begins |
| | 16 | direction of road segment (E for east or S for south) |

| Card Group | Cols | Description |
|---|---|---|
| | 19 | road type |
| | 23-25 | value ratio of road segment |

Repeat format as in (11-25) for up to 3 more road segments in cols. (26-40), (41-55), and (56-70). NOTE: Roads in only one jurisdiction can appear on a single card.

| | | |
|---|---|---|
| 13b Road Cards | 1-2 | two-digit row number of intersection |
| | 3 | blank |
| | 4 | for intersection of column 69 with row; road type going south |
| | 5 | For same intersection, road type going east |

Repeat as in cols. (3-5) for each intersection in the row in order of left to right across the board.

For each intersection in row, whether or not roads emanate from the intersection, use three digits; first digit blank, second with road type going south, third with road type going east. For example, intersection of column 71 with a row has column 6 blank and road types in 7 and 8. Intersection with 73 uses columns 9-11. Intersection with 75 uses columns 12-14. There are 25 columns of intersections, or 75 card columns required (col. 3 to col. 77).

A road on a jurisdiction boundary is assigned to the lower-number jurisdiction. The road value ratios are set to the maintenance levels specified in Card Group 32.

**********Blank Card**********

| | | |
|---|---|---|
| 14 Undeveloped Highway Land | 1-2 | 'HY" |
| | 3 | jurisdiction |
| | 11-15 | parcel location |
| | 16-20 | percent of land owned but undeveloped |

Repeat format as in (11-20) for up to 6 more parcels in cols. (21-30), (31-40) ... (71-80). NOTE: Undeveloped Highway land for only one jurisdiction can appear on a single card.

| Card Group | Cols | Description |
|---|---|---|
| | **********Blank Card********** | |
| 15 Team Cash (one for each economic team) | 1-2* | team letter |
| | 11-20 | previous cash balance/$1000 |
| | 21-30 | number of loans for which this team is the borrower |
| | 31-40 | dollar value of time for PH |
| | 41-50 | dollar value of time for PM |
| | 51-60 | dollar value of time for PL |
| | 61-70 | cash balance |

(A team's loan cards follow each team cash card if there are any loans outstanding. One loan per card.)

| | | |
|---|---|---|
| Loans | 1-3* | team letter of team lending (OU for outside) |
| | 4-6* | remaining term |
| | 7-9* | interest rate in mils (.1 percent) |
| | 10* | '0' if loan was originally short term (2 rounds) or '1' if the loan was originally long term (25 rounds) |
| | 11-20* | amount of loan/$10,000 |
| | **********Blank Card********** | |
| 16 Municipal Services Salaries | 1-5 | salary offered a low-income worker (in $100's) in jurisdiction 1 |
| | 6-10 | salary offered a middle-income worker (in $100's in jurisdiction 1 |

Repeat as in (1-10) for jurisdictions 2 and 3 in cols. (11-20) and (21-30) respectively.

| Card Group | Cols | Description |
|---|---|---|
| 17 School Salaries | 1-5 | salary offered a middle-income worker (in $100's) in jurisdiction 1 |
| | 6-10 | salary offered a high-income worker (in $100's) in jurisdiction 1 |
| | 11-15 | middle-class part-time units requested in jurisdiction 1 for adult education employment |
| | 16-20 | high-class part-time units requested in jurisdiction 1 for adult education employment |

Repeat as in (1-20) for jurisdiction 2 and 3 cols. (21-40) and (41-60) respective

| | | |
|---|---|---|
| 18 Bus Salaries | 1-5 | salary offered by bus company/$100 |
| | 6-1 | salary offered by rail company/$100 |
| | 1-2* | department name (HY, UT, MS, SC, PZ, BU, RR) |
| | 3* | jurisdiction (1, 2 or 3) - blank if BU or |
| | 4-5* | interest rate in 1/10 percent |
| | 6-7* | remaining term |
| | 8* | "0" if current bond (originally 2 year t<br>"1" if capital bond (originally 25 year t |
| | 9-14* | amount of bond/$10,000 |

Repeat as in cols. (1-15) for up to 5 bonds in cols. (16-30), (31-45), (45-60), (61-75). Use as many cards as necessary.

**********Blank Card**********

| | | |
|---|---|---|
| 20 Taxes, Land Bid and Outside Construction Charges | 1 | jurisdiction |
| | 2-6 | land tax rate |
| | 7-11 | building tax rate |
| | 12-16 | resident income tax |

| Card Group | Cols | Description |
|---|---|---|
| 20 Taxes, Land Bid and Outside Construction Charges | 17-21 | employee income tax |
| | 22-26 | resident auto tax |
| | 27-31 | employee auto tax |
| | 32-36 | personal goods tax |
| | 37-41 | personal services tax |
| | 42-46* | percent of bid price charged for land bid |
| | 47-51* | percent above value for outside construction if local CI is being used (See Option Cards, Card Group 3a) |

Note: All rates are in .1 percent

Note: The last two items on this card should appear on one card only, since those parameters do not vary by jurisdiction.

**********Blank Card**********

| | | |
|---|---|---|
| 1 Assessment Ratio | | blank |

2 Appropriations

Must be in the order of HY, UT, MS, SC, and PZ, BU, and RR. 1 card per department type. Although UT, BU, and RR cannot receive appropriations, their cards must be included, e.g., UT followed by 78 blanks.

| | | |
|---|---|---|
| | 1-2 | department (HY, UT, MS, SC, PZ, BU, RR) |
| | 3-12 | current appropriation-Jurisdiction 1 |
| | 13-22 | capital appropriation-Jurisdiction 1 |

Repeat in (12-42), (43-62) as in (3-22) for Jurisdictions 2 and 3.

| | | |
|---|---|---|
| 23 Rents (8 residences per card) | 1-5 | location |
| | 6-10 | rent per space unit |

Repeat in (11-20), (21-30), (31-40), (41-50), (51-60), (61-70), (71-80), as in (1-10) for up to 7 more parcels per card.

| Card Group | Cols | Description |
|---|---|---|
| | **********Blank Card********** | |
| 24 Bus Routes (one card for each route's general information and after it, one or more cards for detailed stop and turn information for that route) | | |
| | 1-3 | level of service |
| | 5 | "1" for Bus |
| | 6-10 | route number |
| | 11-15 | number of turns (exclusive of start and end points of route) |
| (detailed route information) | | |
| | 1-5 | starting point of route |
| | 6-10 | location of turn or end point |
| Repeat in (11-15), (16-20), (21-25) . . . . (76-80) as in (6-10) until end of route. | | |
| | **********Blank Card********** | |
| 25 Rail Stations | 1-5 | 'RLSTA' |
| | 6-10 | number of stations on the board |
| | 11-15* | intersection where rail station is located |
| Repeat in cols. (16-20), (21-25) . . . (76-80) and also on additional cards from (11-15) if needed for all the stations. | | |
| | **********Blank Card********** | |
| 26 Unused Rail Land | 1-5 | 'RLLND' |
| | 6-10 | twice the number of parcels on this card |
| | 11-15 | parcel location |
| | 16-20 | percent of land owned by RR department but not used |
| Repeat in (21-30), (31-40) . . . (71-80) and on additional cards from (11-20) for as many parcels as needed. | | |

| Card Group | Cols | Description |
|---|---|---|
| | **********Blank Card********** | |
| 27 Track Segments | 1-5 | 'RLTRK' |
| | 6-10* | intersection pair which defines track |
| | 11-15* | segment |
| | 16-20 | location of parcel over which any part of track segment is above ground |

Repeat as in (16-20) in (21-25) up to (71-75) for up to 11 more parcels. Use as many cards as is necessary to indicate all track segments. Use one card per track segment.

**********Blank Card**********

28 Rail Routes (one card for each route's general information plus one or more cards for detailed stop and turn information for that route)

| | | |
|---|---|---|
| | 1-3 | level of service |
| | 5 | '0' for rail |
| | 6-10 | route number |
| | 11-15 | number of turns and/or stops including start and end points |
| | (additional cards for each route) | |
| | 1-5 | intersection of stop and/or turn |
| | 10 | 0 - if stop or stop and turn |
| | | 1 - if turn only |

Repeat in (11-20), (21-30) . . . (71-80) until last stop.

**********Blank Card**********

29 BG/BS Contracts -- (2-7 cards per department)

| | | |
|---|---|---|
| Card 1 | 1-2 | department ('MS' or 'SC') |
| | 3 | jurisdiction of department |
| | 4-8 | number of contracts (up to 6) |

| Card Group | Cols | Description |
|---|---|---|
| Card 2-7 (up to 6 contracts, a maximum of 3 for BG and 3 for BS per department) | | |
| | 1-2 | "BG" for BG contracts |
| | 6-7 | "BS" for BS contracts |
| | 12 | team owning BG or BS |
| | 13-17 | location of BG or BS facility |
| | 18-20 | percent of total business to be given to this establishment |
| **********Blank Card********** | | |
| 30 Boycotts (economic or social) | 1-2 | team boycotting |
| | 3 | land use boycotting |
| | 4 | class boycotting (1-low, 2-middle, 3-high) |
| | 5 | function boycotted (0-shopping, 1-employment) |
| | 6-10 | location boycotted |

Either class or land use should be given; not both.

| | | |
|---|---|---|
| **********Blank Card********** | | |
| 31 Bus/Rail Fares | 5 | 1-for rail; 2-for bus base fare |
| | 6-10 | base fare in cents |
| | 16-20 | fare increment per mile |
| | 21-25 | value ratio of equipment |
| | 26-30 | maintenance level of equipment |
| **********Blank Card********** | | |
| 32 Highway Maintenance Levels | 1-5 | maintenance level road type 1 Jurisdiction 1 |
| | 6-10 | maintenance level road type 2 Jurisdiction 1 |
| | 11-15 | maintenance level road type 3 Jurisdiction 1 |

| Card Group | Cols | Description |
|---|---|---|
| Repeat in cols. (16-30) and (31-45) for jurisdictions 2 and 3 respectively. | | |
| 33 Education Level (1 card per residence) | 1-5 | parcel location |
| | 6-8 | education level - high class on parcel |
| | 9-11 | education level - middle class on parcel |
| | 12-14 | education level - low class on parcel |
| **********Blank Card********** | | |
| 34 Welfare Payment | 1 | jurisdiction (1, 2, or3) |
| | 2-6 | welfare payment per unemployed worker (in $100's) |
| **********Blank Card********** | | |
| 35 Prices for Outside Purchases | 1-10* | Price per CU for Outside PG or PS (in 100's) |
| | 11-20* | price per CU for Outside BG or BS (in 100's) |
| | 21-30* | price per MG for Outside water (in 100's) |
| | 31-40* | price per MG for Outside water for residences with private utilities |
| 36 Topographical Restrictions and Preempt Land | (input by rows) | |
| | 1-2 | row number (12-60) |
| | (6-8) up to (78-80) | 3 columns per board square for given row (coordinate numbers: 70-118) containing percent of square which is undevelopable. |
| **********Blank Card********** | | |
| 37 Government Employment Locations | 1-10 | Rail employment location |

Repeat format as in (1-10) in cols. (11-80) in order of BUS, MS1, SC1, MS2, SC2, MS3, SC3.

| Card Group | Cols | Description |
|---|---|---|
| 38 Federal-State Employers | 1-5 | location |
| | 6-10 | number of low-income Pl job openings |
| | 11-15 | number of middle-income Pl job openings |
| | 16-20 | number of high-income Pl job openings |
| | 21-25 | salary offered low-income worker/100 |
| | 26-30 | salary offered middle-income worker/100 |
| | 31-35 | salary offered high-income worker/100 |

1 card per location

**********Blank Card**********

| | | |
|---|---|---|
| 39 Surface Water Parcel Cards | 1-5* | location |
| | 6-10* | volume in MGD |
| | 11-13* | percent of land area consumed |
| | 14-15* | rate of flow in parcels per day |
| | 16-20* | location that water flows into (next parcel) |

Repeat format as in columns 1-20 for up to three more parcels.

**********Blank Card**********

| | | |
|---|---|---|
| 40 Lake Parcels | 1-5* | location |
| | 6-10 | water quality rating |

Repeat format as in cols. 1-10 for up to 7 more parcels.

**********Blank Card**********

| | | |
|---|---|---|
| 41 Individual Farms | 1-2* | code number of farm |
| | 4* | owner (alphabetic code) |
| | 5-6* | farm type (1-11) |

| Card Group | Cols | Description |
|---|---|---|
| 41 Individual Farms (continued) | 8 | fertilizer factor (0-3) |
| | 10-14* | normal (when fertilizer factor is 0) net income before taxes per 1 percent in farm (in $100's) |

Repeat as in columns 1-15 for up to 4 more farms.

**********Blank Card**********

| | | |
|---|---|---|
| 42 Individual Farm Parcels | 1-2* | code number of farm |
| | 4-8* | parcel location |
| | 13-18 | assessed value of farmland on parcel (in $100,000's) |
| | 20-24* | parcel on which farm parcel dumps |
| | 26-29* | volume of water (in MGD) dumped by farmland on parcel |

Repeat as in columns 1-40 for one more farm parcel in columns 41-80.

| | | |
|---|---|---|
| 43 Farm Types Normal Income | 1-2* | code number of farm type (1-11) |
| | 3-5* | multiplier on normal income per percent in farm for fertilizer factor 1 (in percents) |
| | 6-10* | same for fertilizer factor 2 |
| | 11-15* | same for fertilizer factor 3 |
| | 16-20* | parts per million nutrients dumped at fertilizer factor 0 |
| | 21-25* | same for fertilizer factor 1 |
| | 26-30* | same for fertilizer factor 2 |
| | 30-35* | same for fertilizer factor 3 |

1 card per farm type

**********Blank Card**********

| Card Group | Cols | Description |
|---|---|---|
| 44 Municipal Treatment Plants | 1-5 | location |
| | 7-8 | two-letter code for treatment code (for outflow only) |
| | 9 | level of treatment plant |
| | 10 | 0 if intake treatment, 1 if outflow treatment |

Repeat format as in cols. 1-10 for up to 7 more treatment plants.

**********Blank Card**********

| | | |
|---|---|---|
| 45 Intake and Outflow Points | 1-5 | point location |
| | 6-10 | location of UT plant serving district |
| | 15 | 0 if intake, 1 if outflow |

Repeat format as in columns 1-20 for up to 3 more points

**********Blank Card**********

| | | |
|---|---|---|
| 46 Sampling Stations | 1-5 | location (if M, location of UT district which uses dumping point |
| | 6 | P = business point source<br>A = ambient<br>M = municipal point source<br>E = all three kinds everywhere on the board (no location is given in cols. 1 - 5 in this case) |

Repeat format as in columns 1-6 for up to 12 more stations

Note: For a municipal point source sampling station the location given should be that of the parcel on which its outflow point is located.

**********Blank Card**********

| | | |
|---|---|---|
| 47 Water Prices | 1-2 | jurisdiction |
| | 4-5 | two-letter code for activity type (AL for all and it supercedes any prices in the jurisdiction input before it but does not apply to any following). Prices can vary by class by residence type. The first letter is the class (H, M, or L) and the second letter is the residence type (A, B, or C). |

| Card Group | Cols | Description |
|---|---|---|
| 47 Water Prices (continued) | 6 | blank |
| | 7-10 | price per MG |

Repeat format as in cols. 4-10 for up to 10 more activities in the jurisdiction

**********Blank Card**********

| | | |
|---|---|---|
| 48 Typical Rents and Salaries | 1-5* | typical rent per space unit for low-income P1 (in $1,000's) |
| | 6-10* | same for middle-income P1 |
| | 11-15* | same for high-income P1 |
| | 16-20* | typical salary per low-income worker (in 100's) |
| | 21-25* | same for middle-income worker |
| | 26-30* | same for high-income worker |
| 49 Dam Priority Effects | 1-2* | code numeber of river basin |
| | 3 | priority (A, B, or C) |
| | 4-5* | Major Recreation multiplier on consumption for dam Priority A (in tenths) |
| | 7-8* | same for dam priority B |
| | 10-11 | same for dam priority C |
| | 13-14* | flood severity multiplier for dam priority A (in tenths) |
| | 16-17* | same for dam priority B |
| | 19-20* | same for dam priority C |
| | 22* | number of water quality levels to be subtracted from surface water quality rating for dam priority A |
| | 24* | same for dam priority B |

| Card Group | Cols | Description |
|---|---|---|
| 49 Dam Priority Effects (continued) | 26* | same for dam priority C |
| | 31-35* | location of dam in river basin |

Repeat as in columns 31-35 in cols. 36-40, 41-45, etc., for location of each dam in river basin

1 card per river basin

**********Blank Card**********

| | | |
|---|---|---|
| 50 Major Recreation Areas | 1-5* | parcel location |
| | 7* | 1, if the major recreation area is affected by dam priorities in its river basin |
| | 6-10* | percent of parcel in major recreation |
| | 11-15* | PG units consumed at water quality 1-3 |
| | 16-20* | PS units consumed at water quality 1-3 |
| | 21-25* | PG units consumed at water quality 4 |
| | 26-30* | PS units consumed at water quality 4 |
| | 31-35* | PG units consumed at water quality 5 |
| | 36-40* | PS units consumed at water quality 5 |
| | 41-45* | PG units consumed at water quality 6-9 |
| | 46-50* | PS units consumed at water quality 6-9 |

1 card per major recreation area

**********Blank Card**********

51 Economic and Social Histories

This Card Group consists of two sections, each of which has a single card identifying the section, followed by cards containing information regarding previous years.

| Card Group | Cols | Description |
|---|---|---|
| Card one: | 1-4 | 'HIST' |
| | 5-80 | blank |

Followed by:

1 card per economic team, in alphabetical order by team.

| | |
|---|---|
| 1-4 | average rate of return on developments for year t-4 (in tenths of percents) |
| 5-8 | same for t-3 |
| 9-12 | same for t-2 |
| 13-16 | same for t-1 |
| 20-23 | networth (in millions of dollars) in year t-4 |
| 24-27 | same for t-3 |
| 28-31 | same for t-2 |
| 32-35 | same for t-1 |

Card one:

| | |
|---|---|
| 1-6 | 'SOCIAL' |

Followed by:

One pair of cards per social team, in alphabetical order by team.

first card in pair:

| | |
|---|---|
| 1-3 | average quality of life index for low-income class in year t-4 |
| 4-6 | same for t-3 |
| 7-9 | same for t-2 |
| 10-12 | same for t-1 |
| 13-15 | average quality of life index for middle-income class in year t-4 |

| Card Group | Cols | Description |
|---|---|---|
| | 16-18 | same for t-3 |
| | 19-21 | same for t-2 |
| | 22-24 | same for t-1 |
| | 25-27 | average quality of life index for high-income class in year t-4 |
| | 28-30 | same for year t-3 |
| | 31-33 | same for year t-2 |
| | 34-36 | same for year t-1 |
| second card in pair: | | |
| | 1-5 | average salary earned by low-income workers in year t-4 |
| | 6-10 | same for t-3 |
| | 11-15 | same for t-2 |
| | 16-20 | same for t-1 |
| | 21-25 | average salary earned by middle-income workers in year t-4 |
| | 26-30 | same for t-3 |
| | 31-35 | same for t-2 |
| | 36-40 | same for t-1 |
| | 41-45 | average salary earned by high-income workers in year t-4 |
| | 46-50 | same for t-3 |
| | 51-55 | same for t-2 |
| | 56-60 | same for t-1 |

# APPENDIX N

## LOAD DECK INPUT CARD FORMATS

APPENDIX N: Load Deck Input Card Formats

| | |
|---|---|
| I | Boundary Cards (I1, 7X, I2, 14I5) |
| II | Number of Social Decision-Makers (I2, 78X) |
| III | Round Number and Heading (I5, 12A6) |
| IV | Active Jurisdictions (I3) |
| V | Social Decision-Makers (2I5, 3I2) |
| VI | Parcel Cards (I5, I3, I2, A1, 2I3, 3I4, 2(I4, 2I3), 4X, I3, 3X, I8, I8) |
| VII | Time Allocation (2I2, 5I3) |
| VIII | Utility Card (A2, I1, 7X, 7(I5, I2, I3)) |
| X | Terminal Cards (A2, I1, 7X, 7(I5, I2, I3)) |
| XI | Parkland and Public Institutional Land (A2, I1, 7X, 14I5) |
| XII | Municipal Services (A2, I1, 7X, 3(I5, I2, 5I3)) |
| XIII | RoadCards (A2, I1, 7X, 4(I5, A1, 3I3)) |
| XIV | Unused Highway Land (A2, I1, 7X, 14I5) |
| XV | Team Cash (I2, 7X, A1, 6I10) |
| XVI | Municipal Services Salaries (6I5) |
| XVII | School Salaries (12I5) |
| XVIII | Bus/Rail Salaries (2I5) |
| XIX | Bonds (AZ, I1, 2I2, I1, I6) |
| XX | Taxes (I1, 10I5) |
| XXI | Assessment Ratio (6I10) |
| XXII | Appropriations (I2, 6I10) |
| XXIII | Rents (16I5) |
| XXIV | Bus Routes Card 1: (I3, I2, 2I5)<br>Card 2: (I615) |
| | Rail Inputs: |

| | |
|---|---|
| XXV | Station (A5, nI5, mI10) n, m - variable |
| XXVI | Land (A5, I5, 7I10) |
| XXVII | Track (A5, nI5, mI10) |
| XXVIII | Rail Routes Card 1: (I3, I2, 2I5)<br>Card 2: 7 (A2, 3I5) |
| XXX | Boycotts (I2, 3I1, I5) |
| XXXI | Bus/Rail Fares (4I5) |
| XXXII | Maintenance level for raod types (9I5) |
| XXXIII | Educational level (I5, 3I3) |
| XXXIV | Welfare Subsidy (I1, I5) |
| XXXV | Outside Price (A4, 6X, I5) |
| XXXVI | Topographic Restrictions (I2, 26I3) |

# APPENDIX O

## NOTES ON THE LOAD PROGRAM

APPENDIX O: Notes on the Load Program

The City IV load program will load data bases configured for the following models:

City II (1108 Version)
City III (1108 Version)
City III (360 Version)
City IV (360 Version without water system)
City IV (360 Version with water system)

The flexibility of the load program allows the user to load previously developed data bases into the same operating model for which new data bases may be configured.

The model user should be extremely careful when loading a new data base into the model. Whereas the edit program which handles player inputs has many checks against errors, both coding and substantive, the load program makes very few checks on the data submitted to it; it merely allocates the data to the appropriate files for storage according to the card columns and groups in which the data appear. The coding, card punching, design processes and design intentions should be rechecked several times before a data base is loaded. Failure to do so almost always results in many wasted man-hours and much wasted expensive computer time. Even when a data base is completely accepted by the LOAD program, many errors may appear in the first round of output as a result of loaded data errors.

- If the load program blows off the system, there is an error in the data cards. All cards should be rechecked.

- Whenever the load program indicates a data error (which it is programmed to detect for very few data items), the data card should be fixed before the load program is executed again.

- If an error appears in Round 1 output, the loaded data should be checked for errors and omissions.

There are only two types of data errors which do not have significant effects on the rest of the model, and the load program does note when these occur. The first occurs when an economic activity is loaded on a parcel which has less utility service installed than the activity requires in order to operate. If the error is not corrected, the activity will still pay for the full amount of utility service which it requires, and the Utility Department will receive the full revenue. However, the level of utility service on the parcel remains at its loaded value until changed by a Utility Department input.

The second type of data error occurs when the various land uses on a parcel consume more than 100% of the land on the parcel. Before any land uses are processed by the load program (i.e., before Card Group 6 is processed), the amount of land on each parcel is set to 100%. As each type of land consumer is processed, the appropriate amount of land is subtracted from the running total of the parcel's remaining land. If, when the program attempts to decrement that running total, a parcel would have less than zero remaining land, the program prints a message to that effect, and does not decrement the running total, but does register the land use as existing on the parcel. The land use is handled as usual, except that it does not decrease the remaining land on the parcel. In effect, a parcel can be more than 100% used. If a card from card groups 8, 9, or 12, indicates a land requirement greater than the remaining land on a parcel, any undeveloped land appearing on the card is not registered. Only actual land uses can cause a parcel to be more than 100% used. When the program encounters a land error, it prints:

NEGATIVE LAND ATTEMPT AT LOCATION - AMOUNT NEEDED - AMOUNT AVAILABLE

As data is fed to the load program and processed, the program prints output indicating what errors it does detect and, in most cases, prints the information which was on the data card. In the following notes concerning the load program, the program checks on the data are noted as well as the form of the printed output which the program produces for each Card Group. Ramifications of some data errors are traced.

The listing which follows these notes are the data loaded for RAYWID, a large three-jurisdiction data base of 2,500,000 population, and TWOCITY, a two-jurisdiction data base of 300,000 population. RAYWID was developed new for the water model; TWOCITY is a modification of a data base originally developed for the 1108 version.

In order for the listing to fit on standard-size paper, cared columns 73-76 have been deleted, leaving columns 1-72 and 77-80. The listing is intended to be used as an example of a complete load deck, and the missing columns are not essential to the example.

Superimposed on the listing is notation which groups cards beloging to the same Card Group. The Card Group number is also noted.

| Card Group | Notes |
|---|---|
| 1 | If a number greater than 7 appears in column 1, the program prints: INVALID DISTRICT TYPE NUMBER. The RAYWID example contains considerably more pairs of coordinates than are actually required for the definition of the various districts. Note that when one card does not have enough room for complete specification of a district, more cards may be used. |
| 3a | This section of the load deck allows the director to specify how data is being loaded and to determine what model will be run on the data base. These are the Option Cards. It is not a required Card Group, so no blank card is necessary if no director option cards are loaded. |

Use one card per option. They may be loaded in any order. The option code words should begin in column 6, and the remainder of the card to the right of the option code word should be blank. Some option cards contain information to the left of column 6.

1. WATER

This code indicates that the water-related data, card groups 39-50 are being loaded. If this card is not used, the load program assumes that water is not being included in the model, and the water phase of the model does not run. The water related maps do not print and Migration has a different output format from the example shown in the Player's Manual.

2. NOCI

This specifies that the NOCI option is in effect. There must be no CI's loaded. All construction is done by the Outside with no round lag. If this card is not used, construction has a 1-year lag and CI's may be built or loaded.

3. RDLENG

Columns 1-5 should contain, right justified, the length of the side of a parcel in 100ths of a mile. If the number there is greater than 200, the rest of the programs use the water model land requirements. If the length is less than 200, the industries use the HI and LI land requirements and all land uses have City 3 land requirements.

4. NEWFMT

This indicates that land is specified in 1% units. If NEWFMT is not given, land is assumed to be in 4% units. This is significant for Card Groups 8, 9, 10, 11, 12, 14 and 26, where land amounts are coded in 25ths

of parcels in the 1108 version. NEWFMT also indicates that Card Group 35, Outside Prices, has the format shown for it in "Formats for Loading a Data Base". If NEWFMT is not given, the format shown in the "Notes On the Load Program" for Card Group 35 must be used.

5. NEWROAD

This indicates that the road format in Card Group 13b is being used to load roads. If NEWROAD is not used, 13a is assumed to be the road format.

6. LOTRV

Columns 1-5 should contain, right justified, the maximum percent of the salary offered at a job location which a low-income worker will pay in order to get to the job. This percentage is used when a list of potential employment locations is created for a worker. If LOTRV is not used, the percentage is assumed to be 25.

7. MIDDTRV

This is the same as LOTRV except that it applies to middle-income workers. If MIDDTRV is not used, the percentage is assumed to be 20.

8. HIGHTRV

This is the same as LOTRV except that it applies to high-income workers. If HIGHTRV is not used, the percentage is assumed to be 15.

The standard option cards used in City IVwith water are:

bbbbbWATER
bbbbbNOCI
bb250RDLENG
bbbbbNEWFMT
bbbbbNEWROAD

In the RAYWID example, NOCI does not appear as a loaded option card. It must be input to the Round 0 or Round 1 data base. In TWOCITY, the land is input in 4% units, since TWOCITY was originally developed for the 1108 version. Roads are in card group 13a format.

3b There are two reasons that the round number should start at zero. The round number is updated in CITY4. Before that point, two programs check the round number as a basis for deciding

| Card Group | Notes |
|---|---|
| | whether to execute. One, migration, does not run if the round no. is zero. Round 1 output thus has the same population as is loaded into the data base. The other program runs only if the round number is zero. It sets the utility price per unit to $10,000 in each jurisdiction. Note that utility prices are not loaded. Neither can they be input to the Round 0 data base, since when CITY4 is executed to produce Round 1 output, all utility prices are set to $10,000. |
| 4 | A new jurisdiction cannot be created after the load program has been executed. This card group indicates to the print programs how many jurisdictions to print output for. |
| 5 | Team number (1=A, 2=B, etc.) is used instead of team letter in data bases originally developed for use in the City II and City III 1108 versions. Either team letter or team number may be used here. |

Note that in TWO CITY, the last three cards in this Card Group repeat parcel locations for which social control has already been allocated on previous cards. Control was reallocated after the data base was first loaded, and rather than change several cards, the new data was loaded over the old. The last card entered for a parcel is the one that counts.

| | |
|---|---|
| 6 | Data bases developed for the 1108 version: team number is in columns 7-8; column 10 is a one-digit land-use code (0=undeveloped, 1=residence, 2=LI, 3=HI, 4=NS, 5=CI, 6=BG, 7=BS, 8=PG, 9=PS); column 11 is residence type (A, B or C). Team number is used for all team designations in the data bases originally developed for the 1108 version. The TWOCITY example contains both 1108 and 360 formats for this Card Group. |

Land parcel cards need be loaded only for parcels which have local system economic owners. Parcels which do not have local owners are automatically assigned to the Outside as owner.

The only check on this card group is for valid parcel coordinates. A card having invalid coordinates is entirely rejected.

The level of economic activity given in columns 12-14 assumed to be its constructed level. If the director wishes to start an activity with a lower operating level, he should make that input to the Round 0 data base created after the load program is executed.

| Card Group | Notes |
|---|---|

Columns 40-43 (rent per space unit if non-residential) do not require rents. Rents can be loaded in Card Group 23. Any rents appearing in that card group override rents appearing in Card Group 6. If all rents are in Card Group 6, Card Group 23 should contain only a blank card.

The data bases originally developed for 1108 versions of the model have all rents in Card Group 23.

For any parcel which is loaded as having no economic team owning it (including OU as an economic team) i.e., all land is either undevelopable or owned by the government, an assessed value should be given to it in the card group, even though the parcel card will show no economic owner.

7 If columns 9-11 are non-zero for PH, the program sets them to zero but does not print a message to that effect. High-income cannot allocate time to free education. There is no check that low-income does not allocate time to pay education.

There is no way to separate the time allocations of people controlled by the same team and of the same class but living in different jurisdictions. To make such a distinction before the beginning of a game, the director should input new time allocations to the Round 0 data base.

If time allocations are not loaded for a class on a parcel, those PL's take the time allocations of inmigrants of their class. The time allocations of inmigrants are:

| | PL | PM | PH |
|---|---|---|---|
| Extra Job | 40 | 30 | 20 |
| Free education | 20 | 30 | 20 |
| Pay education | 0 | 5 | 20 |
| Politics | 10 | 20 | 40 |
| Recreation | 20 | 10 | 10 |

8, 9, 10, 11, 12, 13a, 14 Special care should be taken to make sure that the parcels designated as being owned by these departments are in fact located within the jurisdictions to which they are assigned by these cards. An error here can lead to many other types of problems and contradictions when the model is run.

8, 9, 10, 12, 13 After the utility cards (Card Group 8) have been processed, the program prints a table showing some information about what was on the cards. The table has the following headings:

| Card Group | Notes |
|---|---|
| | LOC (location of parcel), LVL (level of development of the utility plant there), LND (total amount of land owned by the Utility Department there in 1% units), SQ (the internal program coordinates of the parcel), LDN/UT (amount of land on the parcel which is developed in utility plants) TTL CTV (a column which is always blank). The same format is used for Card Groups 9 and 12. For Card Group 10 (terminals), there is one row for each parcel from which a terminal takes land. For Card Group 12 (roads), DIR (direction, E for east or S for south) is given instead of LVL. There is one row for both parcels from which a road segment consumes land. |

The program also prints the number of cards submitted in each of these Card Groups.

| | |
|---|---|
| 10 | If columns 18-20 do not contain the correct amount of land for the type of terminal being loaded, the terminal is rejected. |
| 13 | It is generally wise not to load roads all over the board or even on half of the roadbeds, since the transportation programs consider all possible routes between parcels and will run for extreme lengths of time if presented with a myriad of alternatives. |
| 15 | The program makes no checks on and prints no error messages for this Card Group. It merely prints the cards as they are processed. The cards must be in alphabetical order by team. |

The only economic teams ever recognized by the program for a game using a particular data base are those initially designated as in existence by Card Group 15 during LOAD. If the director wishes to allow for the creation of new economic sector teams during a game, those teams must be included in this card group. For example, the director might want to allow for the social sector's development of their own housing complexes, industries, or investment in Outside businesses (stocks). Such social action would have to be done through an economic team. The director could, by designating a few extra economic teams in this card group, give the social sector those extra economic decision-maker codes. Cash balances need not be loaded; a team letter is sufficient here to create an economic team.

The social sector's initial dollar value of time is also loaded in this card group, although there may be more or fewer social than economic teams. The social teams allowed are designated in Card Group 2 and Card Group 5. Card group 2 gives the number of social teams, but Card Group 5 allocates geographic control to those teams. If seven social teams are specified in Card Group 2 but only six are given control in Card Group 5, then only six social teams can ever control Pl's. If there are to be more social than economic teams, then Card Group 15 should contain at least as

many team cards as there are social teams, or else those social teams which are not included here have a dollar value of time of zero. Of course, the director can input dollar values to the Round 0 data base.

18 If water is being used in the model, no card should be included for Card Group 18. No blank card should be used either. If the director wishes to include Bus or Rail in the water model, he must input their salary offers to the Round 0 data base.

19 The only check on this Card Group is on whether there is an invalid department name given on the data card. The program prints the following message if there is an invalid name: ILLEGAL DEPARTMENT

21 At one time during the model's development, assessment ratios were loaded, but now they are set by the LOAD program. The blank card is necessary here, however. The director can change the initial assessment ratios for the game by an input to the Round 0 data base.

22 There is no program check that the departments which can receive appropriations are the only ones given appropriations. If Utilities, Bus, or Rail are given appropriations during LOAD, they will continue to receive appropriations throughout the game, although the appropriations will never appear itemized as such on those departments' output. There is no way to cancel a Utility, Bus, or Rail appropriation through EDIT.

If Planning and Zoning receives a current appropriation in the load phase, it will never be able to spend that money, since the input (edit) program does not acknowledge a current account for Planning and Zoning. However, the Chairman will spend the amount of the appropriation every round.

23 See note for Card Group 6, columns 40-43. If Card Group 23 has some rents, and if there are more than one jurisdiction (as indicated by Card Group 4), then the rents in Card Group 23 are set to 92% of the value punched on the data card. When a two-jurisdiction data base was first loaded into the model, all of the rents were too high. Rather than change all of the rent cards, we changed the program to lower the rents loaded. Card Group 6 is never affected by the number of jurisdictions.

If a rent is specified here for a parcel which does not contain a residence, there is no error message but the rent is ignored by the program.

RAYWID has all rents in Card Group 6; TWOCITY has all rents in Card Group 23.

| Card Group | Notes |
|---|---|
| 24 | The program makes two checks: 1) that the coordinates specified are in fact valid intersection coordinates, and 2) that all portions of a route travel along roads. |
| 25, 27 | The only program check here is that the intersection coordinates are valid. |
| 28 | This Card Group should be coded very carefully because the program does not check that there are stations or track segments where routes are specified. |
| 29 | The program makes three types of checks on the data: 1) that the department having the contract is SC or MS; 2) that no more than three BG or three BS contracts are granted to a single department; 3) that the type of contract specified is with BG (cols. 1-2) or BS (cols. 3-7). |
| 30 | If on the same boycott card both a land use (col. 3) and a class (col. 4) are specified as boycotting, the program rejects the boycott and prints: INCONSISTENT BOYCOTT |

Note that a use (of bus or rail) boycott cannot be loaded. If the director wishes to start the game with a use boycott in effect, he must input the boycott to the Round 0 data base.

| | |
|---|---|
| 32 | If the road format of Card Group 13b is used, then the road value ratios are set to the maintenance levels specified here. If no maintenance level is specified here, the value ratios are set to 100, but the maintenance levels are 0. |

If the road format of Card Group 13a is used, then the value ratio of any road for which a value ratio is not specified in that Card Group is set to the maintenance level specified here. If no maintenance level is specified here, the value ratio of such a road is set to 100.

| | |
|---|---|
| 33 | If the coordinates of the parcel are invalid or if the designated parcel does not contain a residence, the program rejects the data card and prints: ILLEGAL LOCATION |

If educational levels are not loaded for a class on a parcel, those Pl's have the educational levels of inmigrants of their class (PL-15; PM-55; PH-85).

| | |
|---|---|
| 35 | If the NEWFMT option is not used (see notes on Card Group 3a), then columns 1-4 should contain 'P/CU' and all other information on the card should be shifted four columns to the right. |

| Card Group | Notes |
|---|---|

After this Card Group is processed, the program checks that all economic activities have sufficient utility service and that all parcels having utility service are in utility districts. Any discrepancies are noted by printed messages, although the porgram does not reject or modify discrepancies.

36 Lake parcels should be included as parcels entirely topographically restricted, since there is no check in $ BUILD to prevent construction on a lake parcel.

37, 38 The only checks are that the coordinates are valid. If a surface water parcel dumps on a parcel that does not have surface water, the program prints: PARCEL DUMPS ON NON-RIVER PARCEL.

40 The program checks that the parcel coordinates are valid and that the water quality is valid (1-9). A parcel which is a lake parcel cannot have any land use on it.

42 The program checks that the farm parcel's code number matches a farm code number loaded in Card Group 41.

44 The program checks that the coordinates are valid, that the two-letter treatment type code is valid, that column 10 contains only 0 or 1, and that the treatment plant is in a utility district. If a treatment plant of the same type has already been loaded for the utility district, (intake or outflow) the program takes the latest plant, erases its record of the previously-loaded plant, and prints a message that it has done so.

Note that in the sample data decks intake treatment plants have two-letter type codes. Those codes are ignored by the program in the case of intake treatment plants, which do not have type codes.

45 The program checks that the point location has water, that there is a utility plant at the location specified in columns 6-10, and that column 15 contains 0 or 1.

47 The program checks that the two-letter activity type code is valid.

49 The program checks that the dam priority is only A, B, or C and that there is surface water on each parcel designated as having a dam. If no dam priority values are loaded for a river basin, all of the multipliers are assumed to be 1.0 and the water quality effect is 0, even if a dam is loaded in the river basin.

51 Any columns to the right of those specifically designated as data fields are ignored by the program. In the RAYWID and TWO CITY examples, the letter of the team for which the data applies is punched on each card. If the 'HIST' section is omitted from the load deck, the program does not attempt to process any cards for 'SOCIAL'.

# APPENDIX P

## THE VOTE PROCEDURE

APPENDIX P: The Vote Procedure

Players submit input forms with votes for candidates for public office, opinion polls, and measures of governmental performance. Each of these categories fall under the VOTE option. However, none of the player inputs are in the form acceptable to the computer program. Consequently, the game director must recode the vote inputs based on the information from all player vote inputs.

As described in the Input Description Section, Social Sector, of the Player's Manual, players (social decision-makers) submit their inputs for each election or poll and identify the category and purpose of each vote on the right-hand side of their input form. For each election or poll the game director must assemble each decision-maker's votes and then order and punch the voting inputs as described in the following pages.

## VOTE As An Operating Program

The game director must coordinate the vote process with the game operator (see CITY MODEL Operator's Guide). These vote inputs cannot be run (executed) by the EDIT program. VOTE is a separate program like EDIT (input processing), CITYIV (the simulation), LOAD (prepare a new configuration), and MAPS (print extra copies of the status maps). VOTE must be executed following the execution of EDIT. Thus, the sequence of computer cards beginning with @XQT EDIT is:

```
@XQT EDIT
$CVPT/#A/ ....
$OTHER/#B/ ....
etc. (all player inputs except votes)
@XQT  VOTE
All vote inputs and commands (to be explained)
@XQT  CITYIV (to run the simulation)
```

As is explained in the Operator's Guide, variations on the execution of programs are possible. These variations are dictated by the game director according to the purpose of a particular play. Subsequently, it is possible for VOTE to be executed independently of any of the other programs.

Detail on these options will not be presented except to note that the same file reading procedures required to execute EDIT are required to execute VOTE. VOTE, unlike EDIT, does not change any data so nothing is read out to the data tape following the processing of all votes. Therefore, if VOTE is run by itself, the "@FIN" card should immediately follow the final VOTE input (a period), thereby terminating this particular "job."

## The Structure and Order of VOTE Inputs

Assemble all social decision-maker vote inputs by each vote category which represents a separate vote:

1. Election of slate or candidate for particular administration or department for a particular jurisdiction.

2. Measurement of government performance for a particular jurisdiction.

3. Opinion poll on a particular issue.

Each item of information -- either a command or vote -- must be put on a separate card.

The director should note the order of the separate vote categories and for what purpose each vote is taken. The computer program does not distinguish results according to individual categories; it merely tabulates total votes for each letter. Of course, the letters represent slates, candidates, yes/no votes, or relative quality measures (excellent, adequate, etc.). The director must note the meaning of each letter for every vote.

The social decision-makers' votes need not be input in alphabetical order.

On the following cards, all social decision-makers' inputs for the particular vote are entered. Note that they may vote by class of population units they control within the jurisdiction or for all their population units in the particular jurisdiction. The format which must be followed is:

Zy/W

where Z is the social decision-maker's letter

y is either a number which represents socio-economic class (1 for low; 2 for middle; 3 for high) or ignored if the decision-maker elects to have all his classes vote for the same "letter."

/ is a special character

W is the letter which represents the candidate, quality measure, or yes/no response

The final card for each vote must be a period (" ."). For example: (one vote: an election of the chairman for jurisdiction 2. Candidates A, B, C, and D are running.)

| Card Image | Explanation |
|---|---|
| 2 | jurisdiction |
| A/A | all of A's P1's in jurisdiction 2 vote for A |
| B1/B | B's low P1's in jurisdiction 2 vote for B |
| B2/C | B's middle P1's in jurisdiction 2 vote for C |
| B3/D | B's high P1's in jurisdiction 2 vote for D |
| C1/D | C's low P1's in jurisdiction 2 vote for D |
| C2/C | C's middle P1's in jurisdiction 2 vote for C |
| C3/D | C's high P1's in jurisdiction 2 vote for D |
| D/D | all of D's P1;s in jurisdiction 2 vote for D |
| E/B | all of E's P1's in jurisdiction 2 vote for B |
| G1/C | G's low P1's in jurisdiction 2 vote for C |

Note that none of F's population units nor G's middle and high-income population units voted. It is possible that F controlled no P1's in that jurisdiction likewise for G).

The final card signifies the end of the entire voting process (no more separate votes). It must have a period in the first column. Thus, at the end of the vote "deck" there should be two periods (one each on separate cards). The first signifies that there are no more "ballots" for a particular vote; the second period terminates the vote procedure.

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16. Abstracts

City 4 is an operational simulation game in which participants make economic and government decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participant's as any real city would. The City 4 Director instructs the players in procedure and coordinates the overall game play. This manual describes the details of administering the game from the Director's point of view and presents examples of decision codes, formats, and general information necessary to direct the game.

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